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ORIGINAL ARTICLES

Climate and Weather in Relation to Physical Therapy ..... Clarence A. Mills, M.D. 69
Discussed by Drs. Madge C. L. McGuinness, Charles I. Singer, Francis J. Sculty, and Victor E. Levine.

Jacques Arsène d'Arsonval ..... Disraeli Kobak, M.D. 79

Personal Recollections of Professor d'Arsonval ..... Norman E. Titus, M.D. 85

Professor d'Arsonval and High Frequency Currents ..... Edward Coddington Titus, M.D. 87

Impressions of Professor d'Arsonval ..... A. Bern Hirsh, M.D. 88

An Improved Apparatus for Convulsive Therapy ..... Louis Feldman, M.D., and Frederick T. Davis, E.E. 89

New Developments in Audiometry of Interest to the Otologist ..... G. Henry Mundt, M.D. 92

Uses and Abuses of Audiometers ..... Charles E. Kinney, M.D. 94

Present Requirements for Acceptance of Hearing Aids as Determined by the Council on Physical Therapy ..... Howard A. Carter, B.S., in M.E. 98
Papers of Drs. G. Henry Mundt, Charles E. Kinney and Mr. Howard A. Carter discussed by Dr. Kenneth M. Day, Mr. L. A. Watson, Drs. Charles E. Kinney, G. Henry Mundt, and Mr. Howard A. Carter.

Artificial Fever Versus Combined Fever-Chemotherapy in Gonococcic Infections ..... H. Worley Kendell, M.D.; Donald L. Rose, M.D., and Walter M. Simpson, M.D. 103
Discussed by Drs. Donald L. Rose, O. L. Huddleston, William Bierman, Isadore Levin, and H. Worley Kendell.

EDITORIALS

Professor d'Arsonval, Vale! 111

SPECIAL SECTION

Correspondence 112
Science, News, Comments 114

STUDENT'S LIBRARY

Book Reviews 119

INTERNATIONAL ABSTRACTS

Abstracts from Physical Therapy, Radium, Biophysics .. 121

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CLIMATE AND WEATHER IN RELATION TO PHYSICAL THERAPY *

CLARENCE A. MILLS, Ph.D., M.D.

Professor of Experimental Medicine, University of Cincinnati

CINCINNATI

As physical factors influencing the health and general welfare of man over the earth, climate and the weather far outrank all the artificial devices or procedures that have been used in physical therapy. Here we have external influences that markedly alter the very vitality of the human race, driving it forward impetuously in certain places and at certain times, and under other conditions holding it back to a more sluggish pace or even blanketing it down to an existence barely above the vegetative level. Climate produces these effects through its dominance over ease of body heat loss and speed of combustion allowed the body tissues. Weather, on the other hand, with its abrupt changes in meteorologic environment, has to do more with functional disturbances and the initiation of acute disease. In some regions of the earth climatic effects predominate, and in others those of the weather. Northern United States, particularly in the Middle West, has both factors working at full speed upon man throughout his life, with slowly developing effects which suggest dire consequences in future decades. In the southwest, and in certain other regions of the earth, there is almost no weather but a monotony of the slower climatic effects acting through the years. Separate analyses of these climatic and weather effects not only give us an insight into some of the chief motivating forces acting upon mankind, but also afford valuable suggestions for our use in developing new procedures in physical therapy, and provide a logical physiologic background for our understanding of how physical environment affects us.

Climatic Effects Upon Man

Briefly stated, we may say that climate exerts its effects upon man primarily through dominating his ease of body heat loss. Man and other warm-blooded animals live and act only by virtue of a continuous combustion of food materials within their body tissues, with liberation of the energy essential for the performance of the vital body functions. Upon the adequacy of this energy production, we now know, depend such basic functions as growth, body development, fertility, resistance to infection, and the capacity to think and to act. The body is not highly efficient as an energy machine, being able to utilize only 20-25 per cent of its combustion energy in work performance. The remaining 75-80 per cent must be dissipated from the body as waste. If difficulty in this dissipation is encountered, then there occurs an automatic slowing down in the internal combustion rate and a consequent drop in the fraction of this energy the body has for living functions. Growth rate falls, development is delayed, resistance to infection is sharply lowered, and both inclination and capacity to think and to act are reduced. Under continuous external warmth man comes to live at a low energy level, barely above a vegetative existence. With great ease of heat loss, on the other hand, his existence becomes much more vital and dynamic,

* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 6, 1940.

with a restless energy constantly urging him into new thoughts and new action.

This continued stimulation of man's internal combustion by great ease of heat loss in the temperate zone is bringing on signs of stress and breakdown in the body's metabolic mechanism. Probably 85 per cent of tissue combustion is glucose burning, so it is significant that diabetes mellitus — a disease characterized by breakdown in the capacity to handle glucose — is most severe and most frequent in those regions where human energy rises highest. The circulatory system, on which falls the load of transporting from lungs to cells the oxygen needed for the combustion processes, also shows greatest evidence of stress and breakdown rate in these same stimulating regions and in the cooler portions of each year. Hypertension, vascular sclerosis and heart failure at unwonted early ages seem related to this high metabolic load, for non-infectious heart failures show just as close an inverse relationship to outside temperature level through the seasons as does resting oxygen consumption. And with the red cells themselves, as carriers of the oxygen needed in this combustion, we find most frequent and severe exhaustion in their producing tissues (pernicious anemia) under those same climatic conditions where diabetes and circulatory failure are most frequent. Over two-thirds of the American physicians who died in 1939 showed primary circulatory failure of one kind of another.

One advantage of stimulating climates is manifested in the heightened resistance to infection exhibited by residents of regions where the metabolic and degenerative diseases are so severe. Acute appendicitis attacks carry only one-half the fatality rate per 100 attacks in the northern states as compared to those bordering the Gulf of Mexico. Less acute infections such as tuberculosis also run a slower course under stimulating climatic conditions, with a lower fatality rate per 100 cases. In tropical and sub-tropical warmth, infectious diseases replace the metabolic and degenerative ones as major causes of death. Few cases of metabolic or circulatory breakdown occur with the low energy level of life in the tropics, but lowered resistance to infection leaves the way open for bacterial and parasitic invasion of the body tissues.

Cancer illustrates very clearly this relationship of tissue combustion rate to human degenerative diseases. In the stimulating climates of the earth cancer causes over twice as many deaths as it does in the sub-tropics or tropics. Its death rate map is almost identical with that of diabetes. Only with cancers of the skin and buccal cavity is the death rate higher in warm climates. Recent animal experimentation has shown the basis for these regional differences in cancer death rates, for strains of cancer mice raised at different temperature levels provide just as great differences in cancer incidence. In sub-tropical warmth few cancers occur, and a relatively slow course is followed by these few. Litter mates of these same mice, kept under stimulating temperature conditions (but otherwise under identical circumstances), develop cancers much earlier, at a much higher frequency, and show more rapid progress to the death point.

Both chemically induced and transplanted tumors in mice also show much faster development at lower external temperatures, except in the case of skin cancers. These grow faster in mice kept under depressing warmth, when richest blood supply must go to the cutaneous capillary bed in order to facilitate body heat loss. If mice be subjected to heat sufficient to cause hyperpyrexia and the fever increase in tissue combustion, then tumors of all body regions grow faster. It would seem, therefore, that in humans tumors of the deeper tissues are most prevalent in stimulating regions where high

tissue combustion rates prevail, while those of the skin occur more in warmer lands where difficulty of heat loss calls for lower internal combustion and a richer blood supply to the skin. No basis exists for the belief that actinic ray irritation is responsible for the high skin cancer rate of tropical climates.

Here we have the explanation for the marked effect of profound body chilling upon human cancers. Reduction of tissue temperatures to 10 degrees below the normal level almost stops cellular combustion, and should logically produce the degeneration of tumor tissue recently claimed for it.

Weather Effects on Man

Weather exerts its effects quite differently from climate. It takes weeks or months for climatic adaptations to take place in the body's combustion mechanism and in the vital functions dependent thereon. With each brief spell of cooler weather we do increase body heat production through greater muscular activity, but our basal or resting metabolism remains unchanged. It responds to the slower seasonal temperature changes. Weather effects follow a different pattern, having to do more with the quicker physiologic disturbances in body functions brought by sudden shifting in physical environmental factors. The exact mechanism by which weather effects are produced is more difficult of analysis than is that for climate, and is as yet less well understood.

The two most important physical factors of weather are temperature change and barometric pressure fluctuation. Other factors such as precipitation, wind, and the like, act mainly to augment or diminish the effectiveness of temperature changes taking place and the sudden shift in rate of body heat loss. Body chilling, no matter at what temperature level it takes place, is liable to permit initiation of acute respiratory or rheumatic infection. Precipitation and wind accentuate the effects of temperature drops in this respect. Waves of respiratory infection are very prone to follow sudden weather changes, and to occur during seasons of most unstable weather. With us in the northern hemisphere, most unstable weather conditions prevail in mid-winter in conjunction with the year's lowest temperatures. This brings a sharp increase in the health hazards people here must face during winter. Southern hemisphere people are permitted a more even existence through the year because their storminess is more evenly distributed through winter and summer. Their respiratory diseases increase in winter less than half as much as do ours in the north. This weather difference is partly due to the fact that in our mid-winter the earth is some 3.5 million miles closer to the sun than it is in mid-summer, and hence receives more active solar radiation to stir up the atmosphere and bring cyclonic storms and polar cold waves.

A marked peak in respiratory disease comes with winter cold and storms in America. These infectious attacks constitute the major causes of ill health for man in temperature regions. Hence we must regard weather change as a health factor of the very first rank. Petersen, in his monographs, points out some of the chemical changes occurring in the body as sudden weather shifts take place, and some of the types of illness attacks that seem prone to occur at such times. Much more exact information is needed as to just how weather change affects us, information that can be obtained only from studies carried out under laboratory conditions of complete control over all factors. Unfortunately such control over barometric pressure is not available in laboratories where weather studies are being carried out.

It seems likely that barometric pressure changes accompanying shifts in other weather factors, cause a disturbance in tissue water balance in the

body that seriously interferes with organ functions. With declining outside pressure tissues take up water and sweil, much as does a sponge, while with rising pressure they give up water and shrink. Girth measurements of my leg just below the knee show changes of ½ inch or more with major weather changes, while some individuals will show a weight change of several pounds. Such changes in tissue water content may well be responsible for the functional disturbances that come with weather change, especially disturbances in the central nervous system. Perhaps that is why we can think so much more clearly on a cool, high pressure day, and find ourselves vague and easily irritated on days of falling pressure as a storm center approaches. Suicides are prone to occur at such times, and it is then that domestic troubles flare up most readily. Even the animals show these nervous changes before a storm, becoming less reliable and more bellicose. Close study is needed of just what body changes may be associated with such water balance disturbance. I suspect we will find tissue resistance to infection directly involved, so that pressure change will share with temperature change the responsibility for the waves of ill health brought by storms.

In my recent book* are presented storm track maps showing the storm intensity over various parts of North America through the warmer and colder half years, indicating the regions where weather problems are most severe and those where weather change seldom occurs. It is in the upper plains area, upper Mississippi basin and North Atlantic region that greatest storm frequency is felt. During summers the storms follow a more northerly course and are reduced in total frequency as well as in vigor and rate of travel. Summer heat in the South is left with tropical stagnation to make it more depressing for man. Storminess in the southwest is low both winter and summer, this being our one American region virtually free from weather effects. Great use can well be made of it.

Only in certain limited regions of the earth is there great storminess, with its health hazards. North America has the most extensive such area and the greatest intensity of sudden weather variability. West central Europe and the British Isles, the southern tips of Australia and of South America, and all of New Zealand are battered by a somewhat lesser degree of storminess. North central Siberia is affected to an unknown, but probably severe degree, but few people live there to be involved. In addition to these temperate zone storm areas, there are others afflicted with tropical cyclones (hurricanes or typhoons) in which severe pressure changes occur with little or no change in temperature. Such storms involve particularly the Philippines, South China coast and Japan, India around the Bay of Bengal, the West Indies and southeastern coast of the United States, and to a lesser degree the southwestern coast of Mexico. As yet we know little of the contributions these tropical storms make to human ill health.

We have before us, then, a picture of our physical environment as it dominates our lives and our health. Climate and the resulting ease or difficulty of body heat loss controls tissue combustion level and thus affects all the vital qualities dependent upon the energy of this combustion. Life assumes a more highly vital and dynamic quality when body heat can be lost freely, with rapid growth, early development, high resistance to infection, and a wealth of energy for thought and action. In depressing warmth, on the other hand, activities of brain and body are inhibited by difficulty in losing the heat such activities must generate. Air conditioning has attempted to provide a solution for these difficulties, but the solution is prohibitively

* Medical Climatology, Springfield, Ill., Charles C. Thomas, 1939, pp. 56-59.

expensive for the masses and necessitates contrasts in air temperatures indoors and out that seem to promote respiratory and rheumatic troubles in much the same way as do natural storm changes.

What can we do about all this, and what bearing does it have upon the practice of physical therapy? There seems little we can do about it except to achieve a better understanding of what is taking place. As the chemistry of cellular combustion becomes better known, we may find ways of stepping up the combustion level without necessitating the dissipation of more heat. In our laboratory we have just this summer obtained indications that such increased efficiency of tissue combustion can be obtained through thiamin (B_1) administration. This vitamin forms an important and essential link in the cellular combustion of glucose (from which we derive 80-85 per cent of our energy). Increasing its intake permits animals to maintain higher food intake and better growth in severe heat. This must mean an increased efficiency in the use of combustion energy by the body. We are now attempting to find out whether thiamin will also overcome the sharp lowering of resistance to infection which takes place when difficulty in heat loss is experienced.

Many of the physical therapy measures have to do with changes of tissue temperatures, either local or general, so it is important that one appreciate the alterations in vitality which may result. In fever therapy, for instance, tissue combustion is sharply increased as the body temperature mounts, and with this increased combustion must go a heightened ability to fight infection. This point has not yet been investigated directly, but the more rapid growth of mouse cancers we found with prolonged hyperpyrexia, just as with a stimulating cool environment, probably means that tissue resistance to infection is sharply increased during fever. Perhaps fever is, after all, only a protective body response to infection, designed to bring on a mobilization of the body's defensive forces.

Local application of heat, or of radiations or other physical measures that stimulate heat production in the tissues involved, may well produce benefits through this same step-up in the vitality factors dependent upon increased combustion activity. In the application of fever therapy, increased effectiveness might be obtained and deleterious reactions avoided, if thiamin were used in conjunction.

Perhaps some may consider migrational use of different climates as a form of physical therapy. It is physical therapy, of course, constantly working upon man everywhere. Literally millions of people are ill-adapted to the weather or climate of their home region and would be greatly benefited by migration. This is particularly true for the hordes of sufferers from repeated attacks of respiratory or rheumatic troubles in the stormy regions. For them migration to a region free from storm changes brings most welcome relief. More millions in the stimulating middle temperate regions suffering from the metabolic stress of too fast a pace of life, could find relief by migration to the calming warmth of the sub-tropics. There a slower rate of body heat loss tends to subdue the general metabolism and to lessen the load on the body mechanism. Diabetes becoms a milder disturbance requiring little treatment, hyperactive thyroids quiet down, circulatory stress is relieved, and in all ways life becomes more complacent and less urgent.

Lack of detailed knowledge of the many procedures used in physical therapy prevents discussion of any further possible bearings this presentation of climatic and weather effect may have in this field. It would be well, however, always to keep in mind this responsiveness of the body to changes in its physical environment, when devising new methods of treatment or

seeking explanation for the effects of those already in use. It should be borne in mind, also, that the body response in summer heat differs from that in winter cold. Man is far from being a machine of standard qualities. He fluctuates widely from season to season and from one climatic region to another.

Discussion

Dr. Madge C. L. McGuinness (New York): There has been some question in Dr. Mills' mind as to whether climate has to do with physical therapy, but to those who believe that knowledge of climate and weather are prime essentials in the practice of physical medicine, the work of Mills, Petersen, Huntington, and others will take its place with that of Hippocrates and Herophilus, who twenty-five hundred years ago formed the basis of physical therapy by discussing weather and climate and their reactions on men. I have repeatedly stressed that the life and teachings of Hippocrates ought to be obligatory reading and study in our medical colleges.

Physical medicine is predicated on rectifying the pathologic processes which probably are ascribable to the patient's environment or rather loss of his real environment. That is why we prescribe heat, exercise, massage, and other measures to change the concerned environment. It can well be assumed that our ancestors knew that much better than we. In our country the Indian got up and migrated when he didn't like the climate or the environment. Those of us who now live in the East and go to the Adirondacks in the summer, often wonder why such salubrious climate did not hold the Indians. The Indian had a little sense. He knew the Adirondacks and places like them as a playground. He went there in the summer, but you couldn't hold him there in the winter. Those who now go to the Adirondacks during the winter have a lot of difficulties. But they know better than the Indian, of course, for the latter was here only a few thousand years.

The Gaels of old, before the foreign government clipped their activities, always left their villages when summer approached and went up to the shieling in the mountain, where an abundance of sun and fresh air enabled them to fight twice as hard and defeat rival clans or invaders. Herodotus and Hippocrates describe at length the Nomads who lived in their covered wagons and moved from place to place to escape the rigors of winter. These were the first recorded "trailers," whose modern imitators follow the sun to great advantage.

Ecology should be a part of the education of all physicians, and particularly physical therapeutists. Those of us who are especially interested in preventive medicine do not feel quite as disturbed as Dr. Petersen and Dr. Crile about the weather. The important thing is to regulate the environment for the patient, if we cannot send him to the proper climate.

Two years ago, I had an exhibit before our Congress in which some of Dr. Mills' various maps figured, showing what we are to do with climate and our houses, to create a livable environment. I then demonstrated a "climatorium" in the hope that some officials would provide a large building, where we could have every kind of climate that anybody needed. For a dollar a day one could there get as much weather for as long as one required, also bathe and drink various mineral waters or expose one's self to the sun, but thus far no one has appreciated the potentialities of such an arrangement.

The architects agree it can be done, but estimate that a "climatorium" such as described by Drs. Stoedieck and Goldmerstein, would cost millions of dollars. Evidently there are no such appropriations for maintaining the health of the people, while curing the sick attracts notice and calls for hectic legislation.

Air-conditioning is a problem that is bothering many of us. It would be well if we could have properly air-conditioned rooms for various diseases. In the hospitals certain wards and rooms should be given over to those diseases giving most concern. At present we must rely upon thermostatically controlled heaters in cradles for peripheral vascular, cardiovascular, metabolic, respiratory and other conditions. In these "vasculators" the temperature is usually kept at 92 F. Whatever degree of heat is necessary for the patient we try to maintain, so that those with arthritis, arteriosclerosis and others who need warmth get along comfortably. In the summer most of these patients feel well, and we take unwarranted credit for having made a cure. But they come back to us in the autumn with the same complaints if they have not carried out our instructions. So long as the patient is in the hospital or a warm climate he does well. If he is a male and we can make him wear wool in this latitude, he stays fairly well on discharge. If the patient is a female and she won't wear protective underclothing, then troubles are to be anticipated.

With proper air-conditioning in houses a few patients who could afford it were kept living for years. A number of others maintain health and freedom from sinusitis, hay fever, asthma and like conditions by living in the proper environment within, however wintry the blasts blow from without. Many of our theaters, movie houses, hotels and public buildings, with their too great cold in summer in contrast with the hot streets, are often the cause of sudden chilling that leads to infections that are on the increase in our cities. On the other hand, if suitably clad and out of the currents of air eddying from the source of the cooling, much benefit has been derived, a good night's sleep made

possible and renewed energy obtained from two or more hours in a cool environment, during the frequent hot spells that leave the cities sweltering and many persons prostrated.

Speaking of cold, I think Dr. Levine is in the room. He has been in Alaska for four years, so he may tell us something about the cold up there. Dr. Vilhjalmur Stefansson, the Arctic explorer, has discussed the question of the many child marriages in the Arctics in comparison with those in the tropics. In the Eskimo houses they have lamps as oil burners, the first oil burners ever invented, and the temperature is so high that the inmates have to strip and are frequently in profuse perspiration. Dr. Stefansson says that the record kept by the Danish ministers shows there are marriages as early as nine, ten or eleven years and births also, but not many, as there appears to be a marked lack of fertility. Even though during the day they are out in the open, this is usually during the summer. They shut themselves up in the winter and the temperature is almost semi-tropical in their houses.

As to fever, I have never fought fever as such. Whenever possible, I have kept from the family what the temperature is. I feel that fever is necessary, sent by nature to burn up poisons, to get rid of infections. I think that any success that we have had in administering hyperpyrexia is due to the fact that we had that friendly fever that increased bodily resistance. With proper previous preparation for hyperpyrexia, including Vitamin B_1 for increasing appetite and upbuilding, the dangers are greatly decreased. I do not think we should prescribe antipyretics in ordinary fevers. Physical therapeutists, of course, use the cool bath among our other methods.

We do not pay sufficient attention to the temperature in our wards and rooms, particularly after a hot spell, when there is a decided let-down. A sudden cold spell finds the patients chilly, complaining of pains in the joints, the back and elsewhere, because the windows are wide open. Physicians, nurses, attendants, being active, do not realize the rôle played by sudden chilling in frozen shoulders, lumbago, neuritis and the like.

As to cancer and crymotherapy, too little has yet been done to warrant any claims for cure.

We have been most fortunate to have the privilege of hearing Dr. Mills in person at our Congress and we will again read his brochures with renewed interest, profit and pleasure.

Dr. Charles I. Singer (New York): It was with a feeling of genuine pleasure that I welcomed the opportunity to discuss Dr. Mills' paper. I always follow him with great interest, because of his clarity of vision for biologic interconnections, for his logic in arriving at clear-cut conclusions.

We carry home today from here a crystal-clear conception of the fact that the human and his climate constitute one inseparable biologic unit. That in order to survive, in order to stay healthy, the human has to be adapted to the more or less static qualities of his climate, and he has to be able to withstand the more dynamic and sometimes dramatic atmospheric fluctuations which we call "weather."

There is only one point which I want to emphasize. I don't fully share Dr. Mills' pessimism concerning the future of the inhabitants of the North American storm zones. He himself and his followers will greatly contribute to change this dark future, by teaching the average practitioner, and through him, the public, that something can be done about the weather. That if the patient is suffering from an active cardiac condition, a rheumatoid arthritis, or chronic nephritis, he shall escape the storminess of the late winter in the North. He shall stay in the southland — if on nothing else, on his coal bill, and be treated there. And to do so, especially if he shows definite signs of emotional and neuro-vascular instability. The inhabitant of the storm path areas will learn that if young and healthy, he has to challenge his climate, hardening himself through planned gradual exposure to the harsh qualities of that climate.

The average American sticks too tenaciously for his own good to the heat comfort given to him by air-conditioning and modern clothing. I see these invalids, worshipers of human comfort, inhabitants of New York and other large cities, lacking open air exposure in their life program. I see them on our seashores in the early summer, getting chilled from a sea breeze, their lips turning blue from a short stroll on the beach. But fortunately, the lost physical heat regulation can be easily regained by repeated gradual exposures.

Stormy regions breed strong races. The future hardy American Nordic, descendant of present forefathers, will rely more upon the direct defense given to him by his perfect physical heat regulation. His first line of defense is his skin, and not the unreliable indirect defense of clothing and heating to protect him from sudden changes in the atmosphere. His basal metabolic range, his endocrine, mineral, and neurovascular balance, will hardly be disturbed behind these perfect defenses.

This strong race of the future, born by survival of the fit, and by acclimatization, escaping if sick and proudly challenging his climate, if healthy, will remember Dr. Mills' work as the "basic pillar of modern medical climatology."

Dr. Francis J. Scully (Hot Springs National Park, Arkansas): It has long been known that the weather has a profound effect on people and their ailments, but we are indebted to Dr. Mills for presenting such an interesting and enlightening view of the mechanisms which produce these effects. In regard to climate one has only to travel to note the slowing effect on activities of mankind in the tropics and the bustling activities in the more temperate zones.

As the main weather changes, Dr. Mills has stressed temperature and barometric

variations. However, I believe that the humidity, or the amount of water vapor present in the atmosphere is of equal importance. It is true that humidity depends on temperature and is obviously greater in the tropical regions than nearer the poles, and in hot weather more than in cool weather. With higher temperatures we note an increased circulation to the skin and an increase in perspiration to aid in the loss of body heat, but a humid atmosphere would interfere with this heat loss by reducing the evaporation of moisture from the skin. Another important factor is the movement of the air. Winds are great distributors of temperature and moisture over the surface of the country. Moist winds have a chilling effect which may prevent invalids from taking sufficient outdoor exercises. Cool, not cold, dry breezes on the other hand are refreshing and stimulating. Sunshine is also of great importance. Everyone is familiar with the depressing effects of continued cloudy weather and the exhilarating response to sunshine. Thus we see that the effect of temperature cannot be considered separate from those due to humidity, the winds, and sunshine. All must be taken into account in estimating the influence of weather on bodily conditions.

I was very much interested in the remarks on thiamin (vitamin B_1). The beneficial effects of this drug in neuritis and in exhausted states are well known, and its recent application to such diseases as atrophic arthritis has been followed by improved appetite, better assimilation of food, and a more stable nervous state.

At Hot Springs National Park there has been an excellent opportunity to observe the migration of people for change of climate and for physical therapy. Here are seen patients from all over the United States, those from the north coming during the winter and those from the south during the summer session. It has proved a mecca for rheumatic sufferers as well as the aged, those suffering from hypertension, vascular disorders, and those seeking relief from recurrent respiratory infections. With their migration from home they also have freedom from home anxieties and from the stress of their work, which fact, as pointed out by Dr. Mills, allows a slowing down of the general tension of the body, lessening the strain on the heart and circulation, as well as the nervous system. In planning physical therapy in relation to climate and weather Hot Springs National Park would be an excellent choice. On account of its central location it offers an unusual opportunity for outdoor activities because of its warm sunny weather in the winter and its dry clear weather in the summer season.

Dr. Victor E. Levine (Omaha, Nebraska): We all know that Dr. Mills is a pioneer in climatology and, like all pioneers, it is very important from the psychologic standpoint to push a project or an opinion to its utmost so that it may gain wide popular approval. However, I think that climate, while being very important in the treatment and well-being of humans, is one of the many things that brings about optimal good living.

I want to take up a few problems that are somewhat doubtful in my mind. Dr. Mills said that the people in the South, in New Orleans, are less active mentally than those of the North. It isn't altogether the climate. My impression is that many of the southern people and many of other parts of the United States gravitate to places where mentality might be more appreciated or where they might have a greater opportunity. Is it not true that many of the southern students go to other universities, say, for example, Harvard, and that many of the brilliant students in Harvard come from places outside of the stormy areas?

I am reminded of the fact that at one time they took a sort of survey of the mentality of the medical students in Harvard, and the medical students stood very high. In breaking down the results, it was found that this high average was due to several students who came from Nebraska, Louisiana, and other parts. In the same way, people of histrionic ability or glamour might gravitate to Hollywood, so that opportunity is very important, I think. Furthermore, may we not take into account that civilization, with its great mental spurt, started in the tropics or the semi-tropics, in Palestine, in Egypt, in warm Rome, in warm Athens, in Carthage, in Persia, and Syria, and then traveled north, and the great Hippocrates who is mentioned so often borrowed a good many of the ideas of medicine from the Egyptians and the Hindus. So there again we might find some matter for discussion.

I am more familiar with the Eskimos, and since they are way up north, I might make a few more remarks. You hear so much misconception about the Eskimo, that you may blame it on the climate. For example, it is said that Eskimos are not prolific. You might say the climate is so cold that prolific abilities are subdued, but when we look more deeply into the situation, we find that they have a habit of killing off their girls, in order to reduce the number of children. A family that did not have any children would get a child from a more fortunate family, so that things equalled up.

Now, fertility is immensely increased. Well, we might say the Arctic is getting warmer, and it is, but another fact must be considered. In the days of yore, the Eskimo mother would nurse the child for three or four or five years. That is where the child got its milk. Now with the advent of the white person, they nurse the child only for one year. Lactation being short, you can readily see that we have a remarkable increase in the fertility of the Eskimo. As a matter of fact, the highest I have counted is twenty children in Point Barrow. That is not because the climate has changed, but because the mode of living has changed, and if the people of the equatorial regions are submissive and very much subdued and complacent, surely the Eskimos I know are very complacent, as a matter of fact so complacent that they

have no word in their language for either revenge or divorce. And yet they live in a climate which is very much below 25 F. for the greater part of the year, that is to say, often 25 degrees below freezing point, and where the sun appears not very often. It doesn't appear at all for about six months, so you set your alarm clock to know when to go to bed.

This problem of climate has suggested a few questions that I am at the moment throwing open for general discussion. The blood pressure in the tropics is low, and as we go farther north, into more stormy or more favorable areas, the blood pressure is high. The Eskimo blood pressure is lower than the American blood pressure. Yet they have lived in a climate which is much cooler than the climate in Cleveland or farther north.

Another thing I would like to find out is this: Homicide has some relation to weather changes, according to Dr. Mills. There is no homicide among the Eskimos, and we blame it on the climate. Oh, yes, there is now. They have introduced liquor among the Eskimos. The Eskimo has no immunity to liquor, while we have had at least five thousand years of immunity, so this introductoin, with the climate still the same, has caused an increase in the homicide rate.

Let me cite some other illustrations. Leprosy was very common a century and a half ago in Norway and Sweden, and was, therefore, common among the Greenlanders. The Eskimo is a Greenlander. Having been wiped out in Norway and Sweden, it is no longer common in Greenland.

Diabetes, which is certainly severe in winter, should appear in greater intensity among the Eskimos, yet among three thousand Eskimos, which is about 25 per cent of the population of Alaskan Eskimos, there isn't a single case of diabetes.

Another disease, toxic goiter, which surely represents a condition where you have a climate that adds to our great activity, certainly should be rife among the Eskimos, and I have discovered only two cases of toxic goiter among five thousand Eskimos, and I can explain those. They represent two half-breeds, who are living according to the dictates of the husbands, who are white, and I think they have adopted many of the ways of the white, which are far from physiologic.

I think we have forgotten three facts: First, that we have a tremendous adaptivity as human beings. The memorable trip of Peary to the North Pole, was made with the aid and only the aid of Henson, a Negro. Some of the best trappers and best hunters, the ones who have made trips possible for many of our explorers are Negroes. They were helped by sailors and assistants who came from the Fiji Islands and from the Philippine Islands.

Another point I want to make is that climate is important for a certain number of individuals who are allergic to climate, while the great mass of human beings can get along in any climate.

One more point I want to make, and that is that if we examine the data relative to climate, we find, first of all, that the data are very sparse, very meager, in many instances, and that there is a tremendous amount of contradictory material with reference to blood pressure, to pulse, to basal metabolism, and many other factors which must be ironed out. However, I congratulate Dr. Mills, because this is a very important subject, and he has been the one to unravel a good deal of the confused data and has evolved a simple science of climatology which sooner or later will bring about a more complete and definite understanding of the relation of climate to health at large.

Professor Jacques Arsène D'Arsonval
1851—1940

JACQUES ARSÈNE D'ARSONVAL

DISRAELI KOBAK, M.D.

CHICAGO

The life of Professor Jacques Arsène d'Arsonval is rooted in the Golden Era of modern France, a life whose footsteps began in the laboratory of the great Claude Bernard and is intimately interwoven in a cascade of luminous intellects that represent an historic background of awe inspiring proportion. His record is legibly written into the scientific progress of the entire world and is so fundamental in importance that a study of his work as well as his ideals could well be the inspirational guidance for future generations. His long and fruitful life brings to the forefront of our memory the picture of a rare personality that has become legendary to the recollection of this generation, because his revolutionary contributions have come to be regarded as resting among the very classics of scientific discoveries credited to the past century. Paradoxically his greatest attainments rest between two tragic periods in France's history — the Franco-Prussian and the present World Wars, and his career parallels the birth of electrophysiology and its recognition in contemporary medicine. His work may be likened to that mystical statue erected to the spirit and service of science that was born in conflict and passed through the vale of ignorance and antagonism, to emerge to final victory.

Fate had it that he was born the son of a country doctor who in spite of his descent from a noble family lived up to the highest ideals of a general practitioner, animated by the intense desire to lead a life of unselfish devotion to those sufferers who sought his aid and advice. It was in such an atmosphere that the boy Arsène even while learning the subjects taught in elementary schools could not but gain the inspiration which born physicians are said to have inherited. The young Arsène pursuing the prescribed classical training before admission to a professional school found his happiest moments when during brief vacation periods he could return to his parental home to observe the pursuits of his revered father. It was a foregone conclusion at that time that the student Arsène would complete his medical education and follow in his father's footsteps.

If ever there was a case of man proposing and God disposing it applies to d'Arsonval who no doubt in his wildest dreams and most intense aspirations never had an inkling of the epochal role he would play in a great and unexplored field of his chosen profession. This is evidenced by the circumstance that he was preparing himself to enter the famous polytechnic school when the outbreak of the Franco-Prussian War in 1870, upset this plan and at the conclusion of that unfortunate campaign reverted to his first love — medicine. But this temporary deviation from what was his father's ambition served young d'Arsonval in good stead. Having undertaken considerable studies in mathematics and physics for which he had an innate talent, he naturally preferred or gravitated toward the exact sciences in relation to medicine. This hunger for fundamentals or concrete data led him to attend lectures held by the then world famous physiologist, Claude Bernard. Here fate presented him with an opportunity which might well be regarded as the determining factor of his whole life. It so happened that a galvanometer used by Professor Bernard did not function and d'Arsonval who was then what the French call an externe of hospitals, offered to repair the instrument. He did this so skilfully and exactly that the great physiologist perhaps divined

the possibilities of the young medical student and decided to direct him into the proper channel suitable to his talents. D'Arsonval in turn saw the great opportunity afforded him, accepted the offer of an assistantship in the experimental laboratory and from then on steered a direct course toward his ultimate goal — electrophysiology.

Claude Bernard sent a written appeal to the elder d'Arsonval in order to obtain his consent for his son to devote himself to experimental research and teaching, because he saw in him hidden talents that would be lost to humanity were he to pursue the routine practice of medicine. Such a consent obtained, Claude Bernard became young d'Arsonval's second father and from this developed an ideal kinship between the great savant and his young associate in research. In spite of the fact that d'Arsonval gave up much of his time to the study of and experimental work in physiology under the aegis of his chief, he nevertheless continued his medical studies and in due time acquired his doctorate at the age of twenty-six. It is noteworthy that his thesis for graduation bore the title: "Theoretic and Experimental Research of the Role of Pulmonary Elasticity." The merit of this original labor must have been great, because the medical faculty of the University of Paris awarded him one of the most coveted prizes.

Photographs of Professor d'Arsonval in various stages of his life. Reading from left to right: (1), as a student at Sainte-Barbe, at the age of 18; (2), as a medical student at the age of 20; (3), as professor of chemistry at the age of 32; (4), as honorary professor at the age of 83.

D'Arsonval has at no time severed his connection with the institution presided over by Claude Bernard. Such were his services that after the latter's death in 1878, the successor to the chair, Brown-Séquard, asked d'Arsonval to remain at his side and to take his place during his absences from that seat of learning. Not only this but within the next few years the Minister of Public Instruction created in a separate building a laboratory in which d'Arsonval could carry on manifold researches. While this laboratory was intimately attached to the Collège de France, in 1882, the French people provided the means for the establishment of a great laboratory at Nogent not very far from Paris, in which d'Arsonval spent the rest of his glorious and productive life.

It would take more space than is at my disposal to even enumerate let alone describe the academic, national and international honors that have been heaped upon this modest and retiring disciple and master of science. The mere fact that the President of the French Republic bestowed upon him the nation's highest award, the Grand Cross of the Legion of Honor, a dignity conferred only upon heads of State or functionaries of equivalent grade, shows not only the recognition but the gratitude of the French Government and people for the great services he has rendered humanity. Learned bodies in

Professor d'Arsonval's laboratory and residence at Nogent.

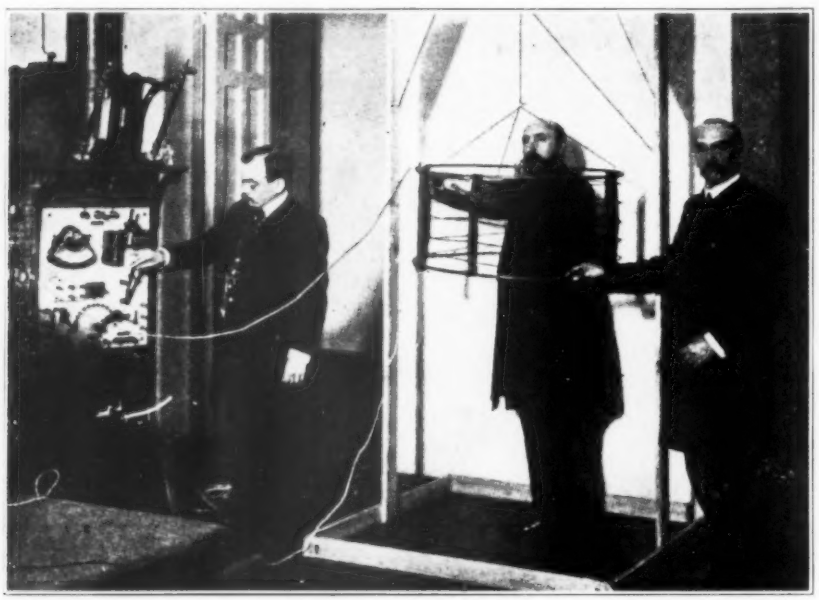
France and other countries have honored themselves by electing him to membership, including one among the "immortals" of the French Academy and it is not without gratification that we mention the award of the Gold Key of Merit of our Congress, an honor by the way which the savant has assured me to have given him great satisfaction. Indeed, d'Arsonval realized that the American medical profession was not fully conversant with all he had con-

Souvenir medal struck in honor of Professor d'Arsonval on his national jubilee.

tributed directly or indirectly to the advancement of physical medicine and he had repeatedly expressed his desire to come to this country after the publication of the Jubilee Number of the ARCHIVES (1932) in his honor. It redounds to the glory of American Medicine that this particular expression of appreciation of his labors preceded by many months a French national jubilee also in his honor.

It is equally impossible to evaluate even the most important of his many scientific publications. It must suffice to point out that he has covered a vast amount of work which has proved fruitful not only in the field of clinical medicine but also in a number of industries. Liquid air and wireless transmission are some of his discoveries developed in his laboratory and eventually perfected to their present state by followers of these fields. Even the discovery of neon illumination by Georges Claude redounds to d'Arsonval's credit because this discovery was effected in his laboratory under his guidance.

In medicine, his contributions can be said to have culminated in his discovery of the law of high frequency currents as a consequence of a series of brilliant and painstaking labors which began with studies of the effects of the galvanic current on excitable tissues. These studies were extended to investigations of the effect of different modulations of the alternating current, which led to his discovery of the rhythmic sinusoidal impulse in therapy. Another step forward was the utilization of the interrupted or alternating



Professor d'Arsonval and assistants experimenting with his autoconduction solenoid.

current in increasing frequencies, which led him to establish the law that neuromuscular excitability becomes lessened with the increase of frequency of the alternating current until a speed of oscillation is reached when all contractility of living tissues ceases and only thermal effects are produced. This represents the foundation of what is today referred to as diathermy both conventional and short wave.

Like all great discoveries, d'Arsonval's has not been spared the distress of certain polemic claims by other workers, notably Tesla. D'Arsonval himself was too unselfish to dispute even questionable claims of priority, but many great names in science have risen to his defense and have shown beyond peradventure that both in the lecture room, years prior to publication, and by the publication itself he definitely established his name as the first discoverer of high frequency phenomena in biophysics and therapy. There can be no question but what d'Arsonval in December of 1890, officially demonstrated at the Collège de France the non-excitability of neuromuscular

Professor d'Arsonval passing a high frequency current through the bodies of two subjects forming a circuit to light an electric bulb.

structure by the high frequency current, and that his publication of this law or phenomenon antedated Tesla's first announcement by several months. This particular fact must be stressed because in spite of all the evidence at hand there are a few authors who perhaps unconsciously stimulated by emotional chauvinism give credit to Tesla.

Already d'Arsonval's discoveries have added a distinct and original chapter in the history of physical therapy. Its potentialities can only be surmised, but if one takes into consideration one of the methods of producing hyperpyrexia, one can have a clue to the future. No matter what developments in this field may arise, the name of d'Arsonval indissolubly will be associated with them as the one who laid their foundation. It is indeed pathetic that this illustrious son of France should have begun his scientific career in the turmoil of a battle lost and that he should have closed his eyes when his native land was overrun by hostile forces. His loyal friend and physician, Louis Chauvois, who was also his biographer, was at his bedside to the very end though himself seriously handicapped by a heart ailment, nevertheless carried his loyalty to the savant up to the last.

D'Arsonval has lived long, and perhaps it was kindness of Nature that in his last few months he drew closer to the beautiful memories of the Golden period that he in part had created in modern France, which brought him some surcease from contemporary worldly strife. His accolade in death was immortality, a distinction which will be recognized by future generations, because his discoveries and teachings have the ring of universal truths.

A list of his most important publications is appended.

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PERSONAL RECOLLECTIONS OF PROFESSOR D'ARSONVAL

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At the conclusion of the First International Congress of Radiology and Electrology held in London in the summer of 1924, it was decided by Dr. Disraeli Kobak and myself to visit Professor d'Arsonval and avail ourselves of the opportunity of becoming personally acquainted with that great scientist.

As we were both limited in our knowledge of the French language, Mrs. Titus accompanied us to Nogent to act as interpreter, after an appointment had been made by Dr. Joseph Rivière of Paris. We went out to his famous laboratory, which is a part of the Collège de France, and were greeted by the even then venerable gentleman. He was neatly attired except for an old cap, which he told us he had worn for more years than he could remember, and carpet slippers. He was greatly interested in the advances in electrology made in the United States and took pleasure in showing us his laboratory which was built for him by popular subscription years ago.

Professor d'Arsonval between Drs. Kobak and Titus, taken outdoors in front of the laboratory at the Collège de France, in 1924.

When we went into the main room of the laboratory I was agreeably surprised to see there in a most prominent position a Van Houten and Ten Broeck ten-plate static machine, made in New York City. The name and place were etched on the glass of the machine so there was no doubt as to its origin. I was even more amazed to see that the Wimshurst charger of the machine had been removed and it was standing on a table in another part of the room. I asked the Professor why it was out of the cabinet, and he told me that due to the good construction of his building and its location the Holtz part of the machine had not lost its charge for years and that he wanted to use the Wimshurst for some other experiments.

It was with this static machine that Professor d'Arsonval created his high frequency current. As we now know, all that it is necessary to change a static machine into a diathermy unit is to connect the inner coatings of the Leyden jars with the two terminals and then couple the outer coatings of the jars with a cylindrical solenoid. Two wires attached near the ends of this solenoid will give an efficient diathermy current. As a matter of sav-

ing space Professor d'Arsonval used, as a source of high potential current, a Ruhmkorff coil in later experiments. He was never satisfied with the diathermy model produced by Gaiffe, Gallot and Pilon of Paris because he said that the capacity of the step-up transformer was too small. He always preached that the most effective diathermy current was produced by a machine of high voltage. This fact has been proved clinically by those who have taken the trouble to study this problem.

A year or so after this first visit I asked d'Arsonval if it was not true that the reason why high voltage diathermy produced better clinical effects was that dielectric loss was also established by the application of plates, and he said it certainly was. If the peak voltage was high enough, heat was generated by dielectric loss as well as that created by the resistance of the tissues through which the current passed. He proposed that I write a paper on this phenomenon but I declined, suggesting that he publish the data because his authority would insure their world-wide acceptance. This, he told me subsequently, he did and the paper was published in France. He said that some day with the use of vacuum tubes, heat would be produced in tissues with air-spaced electrodes, owing entirely to this phenomenon of dielectric loss. This observation preceded by some time the application of this principle we know today as short wave diathermy, for which reason it is about time that credit should be given him for this advance.

Each year when I visited d'Arsonval he questioned me about the Americans whose names he knew through their writings and always said he hoped to come to this country personally to meet men interested in electrophysics. In later years when short wave was being "boomed," he predicted that it would not stand up against what he originally named "electro-thermic penetration." He stated it could never have the bactericidal effects originally claimed for it and that it was too promiscuous a treatment to be relied upon for exact application.

In my teaching of physical therapy, I have always been happy to do the simple demonstration of inductance that d'Arsonval showed me and which I think I demonstrated for the first time in this country. This simple experiment is familiar to everyone today, especially at conventions where the phenomenon of inductance is exhibited by a circle of wire into which an incandescent lamp is connected. When this demonstration was first presented at one of the conventions of the American Electrotherapeutic Association, a loop of wire leading to each terminal of a diathermy machine was placed under a pillow and it was observed with wonderment by the members and visitors that when this ring of fire with the lamp in it was placed on the pillow, the lamp would glow. This was d'Arsonval's original demonstration.

In 1934, when I saw the Professor he presented me with the October issue of the *Journal de Radiologie et Eléctrologie* and autographed it for me. This was the jubilee number of that publication similar to the one of the ARCHIVES OF PHYSICAL THERAPY which was published in December, 1932. All the famous electrologists in France wrote articles on this subject in honor of the Professor. It is profusely illustrated and shows photographs of him since 1869, as well as many pictures of him working in his laboratory.

In 1935, I was given an opportunity to be of service to Professor d'Arsonval which I relinquished to more expert hands. When I was with him one morning, he showed me that the gold leaf and paper plaques in his static machine were becoming loosened and he was upset because he did not know where he could get them renewed. I told him that I would be pleased to repair the defects, but just when I could get the material I could

not be sure. When I left his laboratory I went back to Paris to have luncheon with Dr. Joseph Rivière and met a young American who was then selling American dental instruments in France. I mentioned that I had to get this paper and gold leaf for the Professor's static machine and I was more than pleased when he said that he would like to do the job himself and I could rely upon it that it would be well done because before he came to France he worked in the factory of Van Houten and Ten Broeck in New York. I met him later when he had the gold leaf all ready and I know that we went out to do the job that I would like to have done had I had the time to get the materials together during my short stay in Paris.

At this last visit Professor d'Arsonval told me with great joy how happy he had been at a meeting of the French Academy of Medicine a month before when a portrait of him, given by Dr. Rivière, had been hung on the walls of the Academy and unveiled. He seemed to appreciate most highly this great compliment.

He was also pleased that he had been given some years previously the Gold Key of the American Congress of Physical Therapy and that he had been elected the French member of the Duchenne Society of London. Of course, all these honors were not commensurate to what a great man should have been accorded. His government gave him every honor in its power. Foreign governments and societies all over the world paid homage to him, not only for his pioneer work in the field of high frequency electricity, but for his galvanometer and many other contributions to science. With it all, he was the most mild mannered, quiet person, contented to work in his workshop, reading, I guess, everything that was published and, incidentally, proud of another prominent d'Arsonval, a nephew, who was a famous coach in lawn tennis in Paris and had trained so many of the star French tennis players. I do not suppose d'Arsonval ever participated in any form of athletics but he did frequently speak of his nephew. Whether he had children I never knew and never thought of asking because sitting with him in his study, it was impossible to think of any person other than the little old man with the funny old cap, with the marvelous mind.

PROFESSOR D'ARSONVAL AND HIGH FREQUENCY CURRENTS

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NEW YORK

I greatly regret that I only had one opportunity to meet and talk with Professor d'Arsonval but the memory of this visit has always remained fresh. I met him with Dr. Joseph Rivière of Paris, in his laboratory at Nogent-sur-Marne, and I have never forgotten how clearly he explained the evolution of the physiology of alternating currents. He very concisely brought out the fact that alternating currents progressively lose their ability to cause contraction and fibrillation of muscles as the frequency is increased. Finally when the frequency gets too high for physiological response, the muscles unable to respond become merely a resistance to the flow of the current. With no change in the quality or potential of an alternating current, the physiologic and neurologic re-

sponses gradually diminish as the frequency increases. This orderly sequence of change in neurologic response to the currents of the lower frequencies is disturbed when there is neuropathologic deviation. This phenomenon has been used diagnostically in France for years.

When I saw d'Arsonval many years ago he still maintained a belief that there was a trace of physiologic action still to be expected when currents of the higher frequencies were used to generate what he termed "electro-thermic penetration." In the early part of this century when diathermy was first used clinically, most workers were inclined to agree with this idea. The proof of these by-effects was never established and in time it has become generally agreed that there are no reactions to the diathermy current other than the rise in temperature of the tissues traversed.

Professor d'Arsonval was not only an outstanding electrophysiologist, but he was also an electrophysicist and, in the field of laboratory research, an outstanding electrical engineer. Besides all these purely scientific qualities, he had the particularly pronounced gift of a teacher that made one in his presence so interested in what he was saying that it was difficult to formulate questions concerning the topic then expatiated.

Medical electrology suffered a great deal when it was impossible for d'Arsonval to come to America to instruct workers in this field. Despite this, his contributions were perhaps more appreciated and recognized by the medical profession in America than by those of other lands, and his labors accordingly honored in a manner worthy of their great importance.

IMPRESSIONS OF PROFESSOR D'ARSONVAL

A. BERN HIRSH, M.D.

NEW YORK

My outstanding impression of Professor d'Arsonval when I saw him seventeen years ago in his laboratory at Nogent-sur-Marne, was his simplicity, kindliness and courtesy. He never raised his voice and very precisely explained each point in his monumental work in high frequency current in therapy as he went along in his demonstration. It seems everyone sensed d'Arsonval as a quiet, happy scientist, surrounded with his instruments of research and content with life.

In 1926, at the Sorbonne, in Paris, there was an international scientific congress in which physicists came from all over the world. D'Arsonval was president of this congress and was dressed in his formal afternoon clothes as he presided in the Richelieu Auditorium with commensurate dignity.

When the session of the meeting was over d'Arsonval was given an enthusiastic and sincere ovation at the reception in the garden of the Sorbonne. Mrs. Hirsh and I attended this garden party with Dr. and Mrs. F. Howard Humphris of London. They spoke fluent French and were able to interpret for us in an interesting conversation that we had with d'Arsonval. It was indeed a wonderful garden party, where everyone did nothing but worship the great scientist who was there and seemed so happy to pay him their deepest homage.

Those of us who saw him at work in his laboratory hardly appreciated that at ceremonies he could be such a genial and dignified host.

AN IMPROVED APPARATUS FOR CONVULSIVE THERAPY *

LOUIS FELDMAN, M.D.

Professor of Physical Medicine Middlesex University, and Director of Physical Therapy and Hydrotherapy, Boston State Hospital

and

FREDERICK T. DAVIS, E.E.

BOSTON

In 1934, Meduna introduced metrazol convulsive therapy of schizophrenia which has been reported to have also been used with a great measure of success in various other psychoses. Sakel first brought forth his insulin induced hypo-glycemic shock for the very same purpose which has found many advocates.

Since 1937, various European workers have been developing an entirely different method of producing convulsive seizures both in animals and humans by means of electricity passed through the brain. It is said that the drug method has an indirect effect and electricity a direct one on the brain.

Our interest in physical therapy has led us to develop an improved type of apparatus and technic for "electro-encephalo-shock therapy." In the latter part of 1939, we worked out the fundamental electrical engineering principles which we incorporated into an instrument, which when completed in December 1939, we called the "Commotor."

Our apparatus for the production of convulsions has a current source of the 60-cycle alternating low frequency type, with a flexibility and wide range of control from about 30 to 130 volts and a milliamperage of 20 to 750. This current is further regulated by means of a variable control and a special electronic cut-off timing device placed in the circuit for accuracy and safety. Special indicators on the panel are connected with pilot lights which flash off and on when the current enters the machine and when it is passing to the patient.

From two terminals on the panel there pass two wires which are attached by means of insulated clips to the patient's contact electrodes. These metal, non-polarizable contact electrodes are circular in shape and about two inches in diameter. A rubber self adjustable head band keeps them in contact with the head in the temporal regions. Before application of these moistened electrodes, the resistance of the skin, a very important factor, is further reduced by rubbing a 20 per cent salt paste into the skin of the temporal regions.

The method of computing and individualizing the dosage necessary to produce the convulsion is dependent upon the resistance of the patient's head minus the resistance of the skin and bone, the voltage, milliamperage and the duration of treatment. This is worked out before hand according to Ohm's law.

Technic

Rabbits were used as experimental animals. The weight of each animal was first taken. The resistance of the brain was then determined. The threshold of convulsions was arrived at by applying gradually increasing intensities of current. In our group of animals the minimum dosage with our apparatus necessary to produce a convulsion was 60 volts, 75 milliamperes for one-tenth of a second. In humans our average dosage was 90-110 volts,

* Read before the Staff of the Veterans' Hospital Administration Facility, Bedford, Massachusetts, October 31, 1940.

200-300 milliamperes, time — one-tenth of a second. The animal was placed in a specially constructed wooden cabinet with a glass top which had an opening cut in it big enough to allow the animal's head to protrude above the level of the container. This box kept the animal quiet and allowed for ease of application of electrodes. Two suitable electrodes, as described above well moistened in a 20 per cent salt solution were applied to the temporal regions of the unshaven head which had previously been smeared with 20 per cent salt paste.

The head band was tightened and we were ready to proceed with the production of shock. Depending upon the resistance, the time being constant, namely, one-tenth of a second, the voltage and milliamperage were computed in advance. The control on the variac and the automatic safety timing device were set, the switch turned on. When the pilot light indicated that the current was flowing into the apparatus, the treatment button was pressed. Instantaneously a convulsion was produced. The glass top on the container offered a simple and effective means of observing what reaction took place.

A typical reaction may be divided into the following phases:

(1) Convulsion characterized occasionally, but not always by an initial cry, followed by a marked retraction of the head in tonic spasm with the mouth open, all extremities in extensor spasm, the alae nasi in dilator spasm lasting 20 seconds.

(2) Occasional myoclonic twitchings more or less generalized of 20-30 seconds duration.

(3) General quietude with return of alae nasi function. Occasionally a general twitching, but of markedly less intensity than in previous phases. After about an average of 45 to 60 seconds, the animal appears normal and responds to all stimuli.

During the entire convulsive period until recovery was complete there was absolute unconsciousness, no pupillary responses, but no loss of sphincteric control. In all our animals and 30 humans to date the reaction has been about the same without any apparent deleterious effects.

The apparatus devised by us differs from others of this type in that it facilitates and provides: (1) ease of application; (2) flexibility and wide range control (voltage, milliamperage and time); (3) adjustable electronic safety and timing device; (4) special safety release for treatment switch; (5) no spark coil source, 110 volts instead of 220, 60 cycles instead of 140; (6) a smaller dosage necessary to produce a convulsion (a very important factor for safety and prevention of brain damage); and (7) may be used on both alternating and direct current (rotary converter).

According to European investigators this treatment has proved of value in various psychoses, by the production of an artificial "epileptic fit." It may further be used to find out the value and action of newer anti-convulsant drugs. The contraindications are said to be the same as for metrazol, namely, arteriosclerosis, hypertension, organic cardiac and definite cranial disease. Nerve depressants, sedatives, or opiates must not be administered for at least 24 hours preceding treatment.

Electro-encephalo-shock therapy is absolutely a hospital procedure. It should be carried out under proper supervision and guidance of psychiatrists and neurologists who have especially perfected themselves in the technical details and the fundamentals of this new method. Only under such conditions, can the merits of electro-shock therapy be fairly judged. Abuse of any form of treatment where the fundamentals are not clearly understood, without regard for diagnosis, indications, contraindications, applied by

unskilled operators with bad technic is dangerous. This applies particularly to this type of therapy.

According to the European literature about a thousand patients have been treated by this method. There is no evidence that with expert supervision, proper apparatus, and method of application and dosage, has resulted in any organic or irreparable brain damage.

The advantages of "electro-encephalo-shock" therapy are said to be as follows:

1. There is instantaneous loss of consciousness.
2. The patient suffers no unpleasant memories (amnesia).
3. There is better cooperation for follow-up treatments on part of patients.
4. It produces a convulsion comparable with metrazol and insulin.
5. The effect is direct on brain parenchyma.
6. Treatment is easily, quickly, safely, and accurately applied.
7. Possibility of fractures, dislocations and muscle injuries are remote providing necessary precautions are taken.
8. Apparatus is portable and compact.
9. It is adaptable to patients with difficult veins to reach or where fibrosis or obliteration has taken place after several intravenous injections.
10. Operating from ordinary light source is more economical, than metrazol and insulin, and reduces the amount of work and number of attendants.
11. No psychomotor excitement, fear, headaches, nausea, vomiting, or loss of sphincteric control is evidenced.

Our work was done in Dr. Abraham Myerson's clinic and the machine worked very satisfactorily. Further studies and observations are being made to determine the rationale of this procedure in order to determine what effects take place, if any, in tissues other than the brain. The time elapsed has been too short and the number of patients too few, to definitely decide its therapeutic value. The fact is however, that a new instrument has been added to the therapeutic armamentarium of shock therapy in psychoses. It is said to produce a convulsion comparable with that of metrazol and insulin without any of the disadvantages of the latter. It is for time and those who use this method to determine whether or not "electro-encephalo-shock" therapy is a "blessing in disguise."

NOTE. — We wish to express our appreciation to Drs. Abraham Myerson, Isadore Green, George A. Gaunt, and Clifton T. Perkins, Commissioner of Mental Health, Commonwealth of Massachusetts, for their sincere cooperation.

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(Concluded on page 124)

NEW DEVELOPMENTS IN AUDIOMETRY OF INTEREST TO THE OTOLOGIST *

G. HENRY MUNDT, M.D., F.A.C.S.

CHICAGO

When the audiometer was first used for clinical examination there were three definite faults found with it which were in my opinion never justified. However, it was necessary to meet the arguments whenever audiometry was discussed. There were those who had such a strong feeling of allegiance to tuning forks that to them it was almost sacrilegious to even think of any other method for the subjective examination of the hearing. There were others who thought that there was no scientific or clinical justification for increasing the number of graphs to be used in the examination of patients. There were some who objected to the outlay involved in the purchase of the apparatus. Fortunately at the present one does not have to spend time in the defense of these three points.

I am no newcomer to this field, I started the use of the audiometer shortly after it first became commercially procurable and have been a constant user since. My apprenticeship for audiometry consisted of about ten years of the regular use of a set of Edelmann forks. Since then I have followed the literature on audiometry and I can assert that my idea today of the value of the audiometer differs very little from that which I held ten years ago.

It is necessary if one is to render a fair quality of service that one should have a well regulated technic for examining otologic patients, also a sufficiently catholic view so as not to limit investigation to one and only one procedure. When should the audiogram be made? It should precede any other examination of the ears. It is my practice to inspect the external canals and follow this with audiometry before any manipulation in the ears, nose or throat. I consider this essential because if the audiogram is made after other measures are carried out, one cannot evaluate the psychologic state of the patient, a very important aspect of every individual who is deafened. The careful ophthalmologist determines the vision of his patient before any procedure is undertaken and certainly we should have as accurate a record of hearing as is possible to obtain before any other investigation is made.

The audiogram is a graphic chart of what the individual can hear, this then becomes a record by which all future hearing examinations may be compared. It has the great advantage of showing not alone quantitative but also qualitative hearing. At this time I prefer to consider audiometry more important as a quantitative examination. I am by no means convinced that the audiometer should replace the tuning fork as a diagnostic instrument. The audiometer may be an electric tuning fork, but it lacks some of the control which the conventional tuning fork has. Although fully realizing that the Weber, Schwabach and Rinne tests are by no means simple of clinical interpretation, I still like to have them as part of my examination. The audiometer has demonstrated that it is impossible to make the definite differentiation between conducting and perceptive defects that we once thought feasible, yet the forks add much information which one should have in treating a patient.

* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 5, 1940.

Value of Audiometry

The addition of the bone conductor has increased the value of the audiometer because by comparing air and bone conduction one is able with better than a fair degree of certainty to place the defect in the hearing apparatus. The various methods of masking are of great value, time will be required to find the most satisfactory procedure of eliminating the ear not subjected to direct examination.

There is a great difference in the opinion held as to the desirability of examination of the static portion of the labyrinth in patients with defective hearing. There are those who probably never examine this portion of the internal ear, while a few advocate the examination in all ear patients. I am inclined to agree with any one who carries out all procedures which tend to increase the likelihood of better practice. I do not examine the static labyrinth in all cases except when there is a definite defect in the upper tones.

While it has been known for some years that there was apt to be a definite loss for tones in the upper portion of the scale in middle life and beyond, this knowledge has become more widespread within the last few years. Certainly any one who makes audiograms in the aged should take this into consideration.

When there is a definite loss in the upper tones it still seems advisable to try to discover some general factor which may contribute to or cause this condition. In other words, perception apparatus lesions may be caused by general physical defects, while conductive lesions are more apt to be of local origin.

In the case of some young individuals whose hearing is definitely below the normal of one hundred per cent, but seems to be normal for them, and there can be found no reason to account for this lowering, many obtain auditory improvement by training. It is well for one to keep in mind that there are people who have no difficulty with their hearing and who are not considered deafened by their family and friends who do not reach normal hearing on the audiometer. It is my opinion that in these cases an effort by training and all other means should be made to improve the function. It should not be overlooked that "normal" is an individual state in hearing as in any other function.

Audiometry as a standard method for determining the eligibility for industrial employment has many obstacles to overcome before it will be accepted by employers and labor. When, however, a study is made of an employee with a hearing defect an audiogram should be one of the requirements for a complete report.

Audiograms should and do have in some cases a very valuable place in medico-legal practice. There must be some improvement in making, and interpreting audiograms before they will be generally useful in compensation claims.

Probably the more recent use of audiometry and one of its broadest fields is in determining the type of hearing aid which should be used by a patient. With a proper audiogram it is now possible to fit a better adapted hearing aid than is possible without it. This practice is in its infancy and will make great strides in the future.

One of the most valuable contributions by audiometry is the development of new studies and interpretation of hearing and its tests. It has changed the interpretation of the subjective tests and is destined to yield more accurate information regarding auditory defects.

There is an increased interest in the group audiometer for the examina-

tion or screening of school children, but this subject is beyond the scope of this paper.

To recapitulate, I wish to stress the value of audiometry in otolaryngology. It has also a real place in prescribing hearing aids which should be done by the otologists rather than by laymen.

(For discussions of this symposium please turn to page 100)

USES AND ABUSES OF AUDIOMETERS *

CHARLES E. KINNEY, M.D.

CLEVELAND

The title for this paper was selected with two objects in view. First, it enables me to present some of the deductions about audiometry after ten years of personal experience, and secondly, to point out some of the misconceptions and abuses that have arisen and are challenging this method of examination.

At the outset, it will be well to define a few terms. There are two main types of audiometers on the market today. The group or phonograph audiometer must always be distinguished from the individual or pure tone audiometer. The phonograph audiometer was designed for the screening of large numbers of children in order that those with essentially normal hearing in both ears need not be examined individually. It should be noted that I have said that the group audiometer screens out the child with normal hearing. I shall refer to this point later. The pure tone audiometer was designed to provide a more accurate method of testing and recording the ability of a given ear to hear essentially pure tones at several points throughout the range of human hearing.

The definition of a decibel is more difficult because this unit of sound has a physiologic, a mathematical and a physical basis. A decibel is one-tenth of a bel. A bel represents the mathematical power of ten that is the equivalent of the intensity ratio over that of the minimal audible tone in the average human ear. I would like to dwell a moment upon this definition because it is from the rather loose use of the term "decibel" that some of the abuses in audiometry are arising. The standard type of audiometric chart has the intensity ratios written on the corresponding decibel lines.

To illustrate, the 30 decibel line has 1000 written upon it. Thirty decibels is three bels and is therefore ten raised to the third power or 1000. This means that the tone being produced at this point has 1000 times the intensity of the tone at the zero line which represents the minimal tone that can be heard by the average human ear. Now we can see that if a patient has a 50 decibel loss at 2048 and previously had a 60 decibel loss, he can then hear a tone 900,000 times less intense. If, on the other hand, he has a 20 decibel loss and previously had a 30 decibel loss, he is only hearing a tone 900 times less intense. In both cases the hearing was improved 10 decibels.

Most dictionaries state that deafness is the *complete* loss of serviceable hearing. We should therefore refrain from using this term except in those cases where it applies. Impaired hearing should be used in all cases where the loss is only partial.

* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 5, 1940.

Group or Phonograph Audiometer

The group audiometer has and will continue to serve a very useful purpose in public health work. A properly trained nurse or lay technician can satisfactorily conduct these tests and grade the test papers. The supervision of this work should be in the hands of a qualified physician, preferably an otologist. As pointed out in a previous paper, approximately 20 per cent of the children who do not obtain a normal rating in this test have no fundamental hearing loss. The reasons for this are low intelligence, inattention, or foreign bodies in the ear canal. In a recent survey conducted by myself among approximately 1800 school children, who were tested with both the phonograph and pure tone audiometer, 12 children passed a perfect group test but had a definite hearing loss of at least 30 decibels in the higher frequencies. The complete results of this comparison are soon to be published.

Group audiometer testing is a most useful method for the rapid detection of persons whose hearing should be further investigated. No diagnosis of the presence of a hearing defect should be made on the basis of a group test. Statistics as to the incidence of hearing defects made from group surveys have not been properly evaluated. An attempt to determine the degree of hearing impairment in a single person from the results of a group test implies sheer ignorance.

Reports on group testing that have appeared in the medical literature have stimulated the advertising by a hearing aid company that there are 17,000,000 deaf persons in the United States. This is an abuse of audiometers.

Individual or Pure Tone Audiometer

There has been no fundamental change in individual pure tone audiometers since Bunch and Dean introduced the first one in the early twenties. These fundamental points are that one ear is tested at a time, it is an individual test with three variable factors — the patient, the examiner and the audiometer — and the source of the sound is the hum of a radio tube controlled as to frequency and intensity and conducted to the patient by a dynamic receiver. Why most tuning forks were made on the C musical scale has never been clear to the writer but the fact remains that most pure tone audiometers have been set up on the same scale; namely, 64, 128, 256, and so on. This point has given rise to several years of discussion in the Council on Physical Therapy of The American Medical Association. The argument was whether an audiometer should produce essentially all the frequencies from about 30 to 15,000 in a continual change or whether it should only be able to produce a few tones in this range; namely, octaves and/or half and quarter octaves on the C scale. The first type was known as a sweep frequency audiometer and the other as the fixed or direct oscillator type.

In order to produce a sweep frequency type of audiometer that could be purchased and used by the average otologist, it was necessary to resort to the beat frequency type of oscillator. This type is quite variable in its response and must often be calibrated. I have found my own instrument of this type to be off as much as 25 per cent.

The American Medical Association adopted the standard that an acceptable audiometer should provide the seven octave tones on the C scale, from 128 to 8192, and that there could be a maximum error of 5 per cent at any one tone. This type works quite well for all practical testing, especially as in the case of two makes of audiometers that have introduced half octave notes above 2048. Since they can build such an audiometer on the direct

oscillator principle, the error factor can be reduced to less than 1 per cent and the life of the apparatus is increased.

Before discussing the two other variable factors in audiometric testing I should like to refer to the kind of room one should use for such testing. It has been stated by writers in this field that one cannot do satisfactory audiometric testing in a room in which the noise level is higher than the average decibel loss of hearing in the person being tested. I do not agree with this idea. Except for fundamental research, testing is done to compare a patient's hearing at one time with what it is at another time and if the surroundings are the same the tests are quite satisfactory. Attention of the person under examination is the essential point, and since outside noise is a distracting influence it is desirable to use as quiet a room as possible. We are preparing to conduct some investigations on the effect of visual distractions on the ability to hear. It is my opinion that impulses coming in over the second cranial nerve have preference over those entering through the eighth nerve. Patients, particularly children, seem to hear better with their eyes closed than they do with them open.

Another variable factor in audiometric testing is the patient. Time does not permit to dwell in detail upon these points and many of these ideas have not been scientifically investigated. I believe that there is a daily variation in the acuity of hearing of a given individual. Admittedly this is slight, but I believe it to be definite. The average person's hearing is most acute during mid-morning. Comparison audiograms should be made at the same time of the day. There is a definite variation in air conduction hearing, depending upon the atmospheric pressure. This is particularly true in those persons whose hearing impairment is due to eustachian tube or conduction type of loss. Menstruation affects the hearing acuity of a normal hearing female and this is definitely true if she has an impairment of the so-called "otosclerotic" type. I have made several audiograms of a man during the past ten years, whose work and financial security has been intimately connected with the stock market, and his hearing changes can be closely superimposed on the Dow-Jones charts for the same period.

The third variable in audiometric testing is the examiner. This brings up the question as to what point we should consider is the acuity of a given ear. In hearing there is a phenomenon comparable to the after image in the eye; that is, most persons hear a tone, or the spoken voice, at a decibel loss level that is lower when the intensity is being reduced than they do when the intensity is started below their threshold and is being increased. Some observers state that the latter point should be used. Personally, I record the hearing at a point half way between the disappearance of the sound while decreasing and the appearance of the same tone while increasing the intensity. As further proof that the examiner is a variable factor, I have tested many patients after two assistants, each trained in my technic, have examined the same persons' hearing and discovered as much as 10 decibels variation in the results.

Binaural and Spoken Voice Testing

Accordingly the important point in discussing hearing impairments is how well can a person hear the spoken voice when using both ears. It is an accepted principle that a person cannot see any better than his better eye. In experiments that we have conducted this does not hold true with respect to hearing. There has been very little work reported on binaural testing. In our work, to date, it would seem that a person can definitely hear better binaurally than in his better ear when the ears are tested separately. This work has been done with spoken voice only. We have not done it with pure

tones. There are two methods of doing this testing; they are by putting the patient in a low sound level room with a loud speaker several feet in back of the patient; the other method is to use two similarly calibrated ear pieces connected with the same audiometer.

One of the better makes of audiometers has a microphone circuit installed in the apparatus which allows one to do accurate whispered voice testing. I have been using this method in conjunction with our pure tone testing for the past eighteen months, and although we have not completely analyzed our records I can offer some generalizations.

When there is a difference of 20 or more decibels in the average pure tone loss between two ears, the whispered voice loss in the poorer ear is less than the average pure tone loss in that ear. When the average pure tone loss is essentially the same in both ears, the whispered voice loss is essentially the same as the pure tone loss. I do not believe that this represents bone conduction perception from the better ear because in cases of unilateral total loss to pure tone perception there is no response to whispered voice even though the other ear is normal. Although the analysis of pure tones may occur in the cochlea, that of the spoken voice must take place centrally with connections to both eighth nerves. There is much room for fundamental research in binaural and spoken voice testing.

Bone Conduction Testing

With bone conduction testing one is trying to determine the cochlear response and eliminate the middle ear. An ideal bone conduction receiver is one that would adequately vibrate the inner ear being tested and not set into vibration any part of the middle ear on that side and in no way vibrate the opposite ear. This has not been devised. The opposite ear response has been fairly well eliminated by masking tones. There are two ideas as to what frequency should be used in the masking tone. One contention is that it should be at the same frequency as that being tested, the other group states that a 60 cycle hum is adequate for all frequencies. I use both types of masking, but as yet have not decided as to their relative values. In either case the intensity must be greater than that in the bone conduction receiver.

An ideal bone conduction receiver should be as large as a patient's head. For practical testing this is out of the question. I do not believe that the very small receiver that is held in place by a slight wire headband gives a true estimate of bone conduction response. The receiver should be held in place by a well-trained assistant.

Some hearing aid manufacturers would have us believe that the making of a pure tone audiogram is all that is necessary in the prescribing and fitting of an hearing aid. If one is willing to believe that all visual defects affecting the human race can be adequately corrected by the clerk selling glasses in the 5 and 10 cent store, then the former idea is correct. I do not believe in this type of medicine. A complete medical history followed by a thorough otolaryngologic examination, including tuning fork testing, would enable one adequately to prescribe all hearing aids.

An audiometric test alone is far from adequate protection to the public. Every person with a hearing defect deserves both. In all fairness I believe this situation has arisen as much out of the indifference of the otologist as out of the zeal of the hearing aid salesmen.

Summary

1. The reduction in hearing loss from 60 to 50 decibels is a far greater improvement than one from 30 to 20 decibels.

2. Any attempt to transpose decibel loss into a percentage loss should be made with the intensity ratio factor in mind.

3. Group audiometer tests are only useful in screening out those children who should be further tested.

4. There are three variable factors in pure tone audiometer testing; namely, the patient, the examiner and the instrument.

5. Much further work needs to be done in the field of binaural and spoken voice testing.

6. Although methods of bone conduction testing are being improved, they are far from perfect.

7. Hearing aids should not be prescribed solely on the basis of an audiometric examination.

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(For discussions of this symposium please turn to page 100)

PRESENT REQUIREMENTS FOR ACCEPTANCE OF HEARING AIDS AS DETERMINED BY THE COUNCIL ON PHYSICAL THERAPY *

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CHICAGO

Hearing aids have been considered by the Council on Physical Therapy since 1935. In that year the late Dr. Austin A. Hayden, who was Secretary of the Board of Trustees of the American Medical Association, observed that the Council would be able to pass on these instruments with greater expediency if it were assisted by a group of consultants who had special training and experience in this field. Hayden recommended to the Board of Trustees that such a group be selected, and in 1936, the Council was authorized to make the appointments.

At the present time (1940) those serving as consultants are: Drs. George M. Coates; Edmund P. Fowler; Isaac H. Jones; Douglas Macfarlan; C. Stewart Nash; Horace Newhart; Burt R. Shurly and William P. Wherry. C. C. Bunch, Ph.D., took over the work of Dr. Lee W. Dean at the latter's request. Paul Sabine, Ph.D., of the Riverbank Laboratories and W. C. Beasley, Ph.D., of the United States Public Health Service, have assisted the Council most generously. Dr. Hayden was the chairman of the consultants until the time of his death.

Consideration of hearing aids presented many problems new to the Council, and it was deemed advisable to pursue a course especially suited to deal with the various questions. A series of joint meetings between the consultants and the manufacturers of hearing aids resulted in better mutual understanding. Conferences of this kind are not amenable to the procedure of the Council on Physical Therapy because of the limited time available during the annual meetings. In all, three meetings have been held with most creditable results. Funds to make possible these sessions were appropriated by the Board of Trustees, which has cooperated most generously with the Council in helping it to carry out this special program.

* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 5, 1940.

Two of the meetings were held in Chicago, the first on August 8, 1937, and the second on August 20, 1938. Minimum requirements for acceptable audiometers were considered for the most part at the first two gatherings and later were adopted and published.[1] In formulating these requirements, the Council was assisted by a previous study of a sub-committee of the American Standards Association, i.e., Minimum Specifications for Audiometers for General Diagnostic Purposes. Although requirements for hearing aids were considered at the meetings, nothing definite was done until the third meeting which took place May 5, 1940. Tentative Minimum Requirements for Acceptable Electric Hearing Aids were considered and finally adopted and published.[2]

In addition to complying with the Official Rules of the Council on Physical Therapy, each firm is asked to submit the following:

1. A unit from stock.
2. Information as to type, model or serial number, stamped or otherwise identified.
3. A graph giving the amount of amplification in decibels at semioctave intervals of C from 256 to 4,096. Tests should be made for any peaks or valleys between these points, and if found should be specified.
4. A statement of the voltage and current consumption.
5. A copy of the guarantee and written instructions, and evidence that adequate facilities for servicing the instrument are available.

The Council also requires that the instrument be free from sizzling, frying, humming, and whistling sounds, the workmanship and material be of first grade, the firm be responsible for ethical merchandising practices, and that the financial status of its agents be given. The rules of the Council regarding acceptability of advertising matter also must be met.

Copies of these requirements may be obtained from the Council. Instruments being investigated at the present time are inspected according to these requirements although they do not formally go into effect until January 1941.

The Council's procedure in considering hearing aids might well be described briefly. Advertising copy, a report of the physical and mechanical characteristics, evidence of efficiency, description, and a unit as it is supplied to the trade are presented to the Secretary of the Council at headquarters in Chicago. The manufacturer's data, advertising and the instrument are turned over to an independent, unbiased investigator who tests the aid in a physical laboratory, either confirming or disproving the data. The investigator tries the instrument on deafened individuals, inspects it for ruggedness, material and workmanship, and reviews the advertising and descriptive matter. The investigator then prepares a report for the Council's attention comparing his findings with those submitted by the manufacturer. If he confirms the latter's claims, the aid is recommended for acceptance. If the claims are not confirmed, the instrument is recommended for rejection. In the case of an otherwise acceptable apparatus for which some of the claims are found misleading, the referee may recommend acceptance with provisions for revision of the advertising claims or for an improvement in manufacture.

This report is referred to the consultants in a confidential communication and they are asked to discuss it. They have before them all of the information as presented by the manufacturer and by the Council's investigator. If the data seem in order, the consultants may recommend adoption. The report is then referred to the Council and it is given consideration in accordance with the regular procedure. Finally, an abstract of the findings of the consultants and of the Council is prepared and after being submitted to the Council, is recommended for publication. If the decision is one of rejection,

it is submitted to the manufacturer who is given thirty to sixty days to reply and make whatever changes may be necessary or withdraw the instrument from the market. If such changes or improvements are not made, the report is then published. A decision of acceptance also is sent to the manufacturer, and he is given a week or so to eliminate any misstatement of facts.

There are now twelve hearing aids on the Council's list of accepted devices; seven are of the carbon granule type, three of the vacuum tube and two of the semi-portable type. Six hearing aids of the vacuum tube type are now undergoing consideration.

It is the opinion of the consultants that hearing aids should be fitted by otologists after a complete otological examination including the inspection of aural polyps and the tympanic cavities for carcinoma or tumor, and audiometric test, tuning fork, voice and whisper test. The physician, the Council believes, is in a better position to analyze the wants of a deafened patient than a technician or salesman. He will know whether lip reading instruction, a surgical operation or the application of a hearing aid is the correct way to solve the patient's problem. When a hearing aid is prescribed, the otologist is better trained to test the efficiency of the aid by voice tests using words, syllables and meaningless phrases. However, the consultants feel this is not the time to lay down any hard and fast rules to the effect that no aid should be sold without an otological evaluation and physician's prescription.

Hearing aids are constantly being considered by the Council and more reports are being published. The number grows, and inquirers can obtain a list of the accepted ones by writing to the office of the Secretary. The Council edits a booklet entitled "Apparatus Accepted" in which audiometers and hearing aids are listed along with other apparatus which have been investigated and reported on.

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Discussions of Papers by Drs. Mundt, Kinney and Mr. Carter

Dr. Kenneth M. Day (Pittsburgh): The three papers you have just listened to are all of value. I believe I can best serve by utilizing the few moments at my disposal in summing up the indications for the different types of hearing aids. I am in the unenviable position of being peculiarly fitted for this since I have been wearing a hearing aid myself for the past fifteen years.

The Council on Physical Therapy has rendered a most valuable service in setting up standard requirements for these aids. This simplifies the selection considerably and enables us to eliminate instruments of poor quality and precision by buying and prescribing only those which have been approved by the Council.

I will not have time enough to compare the merits and faults of the vacuum tube aid versus the carbon aid, but from personal and clinical experience I have reached the following conclusions as to the type of hearing aid indicated for different types and degrees of deafness. In general few individuals will tolerate a hearing aid until they have an average hearing loss of from 30 to 35 decibels, except where accuracy of hearing is essential from an occupational standpoint.

For cases with a slight hearing loss of from 20 to 35 decibels the vacuum tube aid is preferable as with slight or moderate amplification it gives better fidelity of sound and these cases will usually not tolerate the peaking and nonlinear distortion of the carbon aid.

With an average hearing loss of from 35 to 60 decibels the carbon aids serve very well. The loss of hearing is great enough that the individual is forced to readjust himself to wearing an appliance and he soon gets used to the distortion and peaking of the carbon type, which is usually more durable and economical than the vacuum tube.

With an average hearing loss of over 60 decibels, especially if the hearing loss

is not uniform, a high fidelity vacuum tube is definitely preferable. From my own experience I find that when such amplification is needed, the peaking of the carbon variety will often amplify certain sounds to the point of pain and consequent cochlear damage. I believe that I have developed a certain amount of an occupational form of deafness from trying to hear too much with the carbon type.

True, selective amplification to match the hearing curve of the individual is not possible with the carbon, nor has it yet been attained by the vacuum aid. However, over-amplified frequencies can be cut down in the vacuum tube appliance by filters, and this is the only type of aid of value for individuals with high tone, nerve deafness and relatively good hearing for the lower frequencies. The air conduction receiver is more efficient for perceptive or nerve types of deafness, including all cases with a positive Rinne reaction.

The bone conduction receiver is more efficient for conductive types of deafness if there is good hearing for the higher frequencies.

In mixed or combined types of deafness, with a negative Rinne reaction, complete air and bone conduction audiograms are essential and the type of receiver indicated which best transmits the higher frequencies from 1024 up.

Cases with a bilateral, average hearing loss of over 50 decibels can increase their intelligibility, especially for conflicting sounds, by wearing a hearing aid wired for amplification to both ears. However, this entails the added problem of re-education of their own voice modulation due to the plugging off of both ears.

Mr. L. A. Watson (Minneapolis): Dr. Kinney, Dr. Day and I were having a private discussion on how closely we can approximate the desired results in an individual case of hearing impairment with a carbon and vacuum hearing aid, and there is no question but what in the last two years we have made more progress than we probably have in 15 years before that period.

We have learned that one instrument will definitely not fill all types or cases. Some very interesting data have come to light in the last six months, particularly concerning individuals who seem to have a total loss of hearing at certain levels.

Some engineers have discovered that an individual may have a complete loss of all his hearing at one frequency level and that by emphasizing the harmonics of that missing fundamental, as we call it, that they can produce subjectively the illusion of hearing a tone that is actually not heard and give a remarkable increased intelligibility of sound. For example, I have seen this clearly demonstrated in a man with complete loss of hearing at 1,000 cycles where they couldn't be reached at all. One thousand cycles is one of the essential tones in the speech range. By emphasizing the second harmonics or 2,000 cycles, they are able to create subjectively in this person the illusion of the missing fundamental that he actually did not and could not hear, and to remarkably increase the intelligibility of that party for spoken voice and sound that otherwise was very low.

In an open discussion of the subject and the difference between the carbon aid and the vacuum tube aid, I think that one point that Dr. Day brought out is worthy of elaboration; that is, one of the greatest problems in helping people who are hard of hearing has been if we amplify the sound with the usual type of hearing aid by 40 or 50 decibels that that step up or increase in loudness must be applied to all sound equally. If one begins with a sound that is 40 decibels loud, one will bring it up to about 80 decibels.

In many cases of very heavy hearing loss particularly of the severe nerve type, what we call limited residual range of hearing, if the party has 80 decibels of hearing loss he has his hearing range compressed in about 20 decibels, and with most of our experience in hearing aids in the past when he would turn the sound up loud, it would work very well for the more moderate sounds but suddenly somebody would slam a door or break a dish and it would nearly blow his head off. Today we are really able to accomplish much more for that type of case than we ever were before.

Circuits can be arranged in a vacuum tube aid which will amplify only the more moderate sounds but will not be over-affected by very strong sounds, so that an individual who has a severe loss and a narrow perception range can carry on very nicely, hear fainter and more moderate sounds and yet loud sounds at close range will not have the effect of hitting him too large, which Dr. Day brought out. We can also control amplification of the vacuum tube better than in the carbon type. Some may like to know how that is done. It gets right back to the principle of the hearing aid. Both the carbon and vacuum appliances have a microphone that receives the sound waves. It vibrates with them and changes the physical vibrations into electrical impulses. Those in the carbon aid are frequently rather distorted by the carbon action itself and in the vacuum tube aid, if the circuits are right, the chokes, coils, condensers, resistors are right, they can be passed on with comparative fidelity or modified. That is, the electrical impulses as they are amplified by the vacuum tubes can also be qualified and qualitatively changed to increase the strength of the higher pitches or of the lower pitches. Then the impulses that have been so modified and changed are sent up to the receiver and again transformed into physical or acoustic sound waves which have the modified characteristics that have been created in the electrical impulse, and one is able by modifying the sound to create exactly the type of response that will tend to give the best possible results in individual cases.

Dr. Charles E. Kinney: I would like to ask the Secretary of the Council on Physical Therapy, what does it mean when a hearing aid is advertised as having 96 to 100 per cent intelligibility? Does it mean that the hearing aid is accepted by the Council?

Dr. G. Henry Mundt (closing): Mr. Chairman, there is little I can say that will add to the discussion. I think usually we take about 100 per cent the things that Dr. Day says about hearing aids because with his own personal experience he has had an opportunity to evaluate them better than most of us.

There is one thing that I want to insist upon and that is no matter how efficient a hearing aid an individual has, he should learn all that he possibly can about lip reading. It is a very essential thing.

We must not think that we are solving the problem of the individual with a loss of hearing or even a partial loss by prescribing a hearing aid. Only one who lived next door, as I did for many years, to a school of deafened children, the Deaf Oral School, and watched and had them play with his own children, can have any conception of the real results that can be gotten by lip reading. Possibly I shouldn't bring this up, but I am so impressed that the average medical man and many otologists fail to recognize that young children determined to have very much lowered hearing, should be gotten into management at once. I am talking about children two or three years old.

Dr. Charles E. Kinney (closing): To emphasize what Dr. Day has said, I would like to present a very recent case. A man, aged 65, who has absolutely no bone perception, who has a hearing loss of 85 decibels up to about 1500 to 2000 cycles, and then it drops off to complete loss in both ears, came into my office for a prescription for a hearing aid, and after spending 45 minutes with him I discovered he was already carrying around two types of hearing aids in his pocket at the time, and he asked me to prescribe a third hearing aid. This particular man has a sensorium level of practically nil. I found that this man who previously had been in a very good mental condition, today cannot add a simple column of two digit figures and arrive at the correct answer. This man ten years previously had been in business, and here he had two aids already in his pocket looking for a third aid and looking for some hearing. I emphasize that in spite of what any one may say, that patient will never have normal hearing.

A hearing aid is not the total answer of all hearing problems, neither in the young children that have a nearly complete loss nor in many elderly individuals.

Mr. Howard A. Carter (closing): In reply to the question, what is meant by 96 to 100 per cent intelligibility, all the hearing aids that are on the accepted list of the Council on Physical Therapy comply with one part of that claim, 100 per cent intelligibility. That refers to sentence intelligibility. I would say that I could speak or recite 20 sentences here, short ones, and I think everyone here in this room would be able to repeat those sentences back to me. That would be then, of course, 100 per cent. If you missed one, that would be 90 per cent.

So far as the use of the hearing aid is concerned, especially those on the accepted list, they all come up to the requirement as far as sentence intelligibility is concerned.

Now as regards word intelligibility and syllable intelligibility and meaningless statements or meaningless syllables—that is a different problem, and I don't know of any hearing aid that is on the accepted list that will come up to 90 per cent in these meaningless statements. They might. I don't know of any that will come up to 100 per cent. I know that as a fact. On words, yes, they will come up to 96. However, if you take a large number of individuals and pronounce words and even if they had good hearing, I think that you will find that many of them would not get the word correctly. So you won't even have 100 per cent in your control group.

So to answer the question, aid is all right for the sentence intelligibility and 96 probably refers to either sentence or syllables. Some of them come up higher than that, some lower. It largely depends on what deafened person you use it on. As a matter of fact, the Council makes it a point to try an aid on several persons so you will be sure to have an average.

The other part of the question whether or not that was accepted, the answer is, yes.

ARTIFICIAL FEVER VERSUS COMBINED FEVER-CHEMOTHERAPY IN GONOCOCCIC INFECTIONS *

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In a communication addressed to this Congress one year ago,[1] certain newer technical developments in the treatment of syphilis and gonococcic infections with artificial fever were presented. The purpose of the present report is to present the more extended application of these technics as related to the management of gonococcic infections refractory to modern chemotherapy.

It is now generally recognized that the sulfanilyl compounds are not uniformly effective in overcoming gonococcic infections. This may be due to the development of drug fast strains of the organism,[2] to clinical relapse following apparent cure,[3] or to the development of an asymptomatic "carrier" state.[2-4]

That artificial fever therapy was highly effective in the treatment of gonococcic infections in the pre-sulfanilamide era was demonstrated by many reliable investigators.[5] After the application of sulfanilamide treatment of gonococcic infections, attention was temporarily diverted from the value of artificial fever as well as from other modes of therapy of this disease. Chemotherapy alone, however, was disappointing in many instances, and it became necessary to initiate investigations directed toward the discovery of a method of curing the significant proportion of patients in whom drugs alone failed to effect cures.

Stimulated by this desire, we have conducted a series of experiments designed not only to define the role of fever therapy alone but also to investigate various combinations of chemotherapy with artificial fever in such cases.

This series is uniformly comparable as regards resistance to chemotherapy. The only individuals included in this report who did not receive what was considered an adequate course of sulfanilamide or sulfapyridine, or both, are the few who proved intolerant to these drugs as manifested by the development of one or more of the following untoward reactions: extreme nausea and vomiting, blurred vision, acute hemolytic anemia, fever, dermatitis, hepatitis, and jaundice.

Patients with complications of this disease were accepted without selection. No patient suffered from simple, uncomplicated anterior urethritis. Seven patients may be classified as "carriers," since clinically they were completely asymptomatic, the diagnosis having been established solely on bacteriologic findings. Each of these individuals had previously received extensive chemotherapy.

Age alone was no bar to treatment, provided that the diagnostic survey revealed no contraindications. The age limits varied from 16 to 56, the mean age being 27 years.

Wherever possible, a bacteriologic examination of all "contacts" was insisted upon. It was in this manner that the seven asymptomatic "carriers" were discovered.

* From the Kettering Institute for Medical Research, Miami Valley Hospital, Dayton, Ohio.
* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 4, 1940.

Care During Hospitalization

The details of the technical procedure employed have been described in a previous report.[1] In brief, the general scheme of treatment was as shown in the accompanying table:

1st Day	2nd Day	3rd Day	4th Day	5th Day	
Diagnostic Survey	"Pilot" Treatment	Rest	10 hr. session at 106.6 F.	Rest	Examination	Examinations for 3 months.

In order to insure complete control over all the factors involved in the program, all patients were hospitalized. Eligibility for fever therapy was determined after a thorough diagnostic survey which included a careful history, a complete physical examination and all indicated laboratory procedures.

Cultures of the genital secretions were made on two types of mediums: McLeod's[6] and the plasma-agar medium developed by us.[7] During the past year, only the latter was used. The cultures were incubated according to Thompson's simplified technic[8] for the production of increased carbon dioxide tension. At the end of 24 hours, the cultures were inspected and organisms from oxydase-positive colonies were stained by Gram's method.[9] If it was deemed advisable, a pure strain of the organism was isolated and its identity established by fermentation tests.[10]

The majority of the patients received a short "pilot" treatment consisting of one to three hours at 105 F. (40.6 C.). In addition to testing the patients' physiologic responses to fever, this short treatment also served to prepare the individual psychologically for the succeeding longer session. The last few patients included in this report received no pilot treatment preliminary to the long fever session; their reactions during and subsequent to the 10-hour treatment did not significantly differ from those who received the additional pilot treatment.

For the long treatment-session, the rectal temperature was elevated to 106.6 F. (41.4 C.) and was maintained at this level for eight or ten hours. The apparatus employed was the "hypertherm." Throughout the treatment, except for brief rest periods, pure oxygen was supplied by means of the Boothby-Lovelace-Bulbulian[11] nasal mask in quantities sufficient to maintain an alveolar oxygen concentration of 60 per cent or more. At intervals of three hours, the patient received 50 cc. intravenous injections of a 50 per cent solution of dextrose. No other fluids were given by vein. He was encouraged to take by mouth 300 to 400 cc. per hour of iced 0.6 per cent solution of sodium chloride in tap water. The sedative used was pantopon by hypodermic injection in doses of 1/6 to 1/3 grain. The pulse rate seldom exceeded 130 during the maintenance period and averaged 120 to 130 beats per minute. The cabinet doors were not opened except for intravenous injections, for blood pressure recordings, or for comparing the resistance-wound rectal thermometer with a certified mercury thermometer. The constant inspection of the skin, which in earlier years was necessary to prevent burns, is unnecessary. With the low dry-bulb temperatures now used, burns are unknown and even erythema of a mild degree is not seen.

If the bacteriologic examination of the genital secretions after the long treatment session were negative for gonococci, the patient was dismissed from the hospital and was then followed up as an out-patient for at least three months.

Criteria of Cure

The term "cure" is used in the literal sense. Rigid bacteriologic as well as clinical criteria must be fulfilled before the disease is regarded as being eradicated. It is our observation that little reliance can be placed upon the clinical status alone in determining a cure. The clinical symptoms and signs in several

patients rapidly resolved after treatment, yet gonococci were recovered from the genital secretions with facility; although clinically well, additional treatments were given until bacteriologic examinations were negative for gonococci. Those individuals who were asymptomatic from the onset presented no clinical symptoms which could be used as a dependable guide for treatment. For these reasons, we have relied chiefly upon bacteriologic findings in the genital secretions in determining cure.

Periodic cultures were carried out upon each patient for a minimum of three months. In the female, pelvic examinations were made on the first postmenstrual day of each of the three succeeding menstrual periods.

No patient is included in this report who had not been under observation for at least three months.

Experimental Data

This series comprises a total of 83 patients who presented complications of gonorrhea and who were presumably either resistant or intolerant to sulfanilamide or sulfapyridine or both.

The series is divided into the following groups:

1. — Those receiving fever alone:
   - (a) 8-hour sessions at 106.6 F. (41.4 C.).*
   - (b) 10-hour sessions at 106.6 F. (41.4 C.).
2. — Those receiving fever in combination with chemotherapy:
   - (a) 10-hour sessions at 106.6 F. (41.4 C.) with oral sulfanilamide during 18 hours before fever.
   - (b) 10-hour sessions at 106.6 F. (41.4 C.) with intravenous sulfanilamide immediately before treatment.
   - (c) 10-hour sessions at 106.6 F. (41.4 C.) with concomitant promin.
   - (d) 10-hour sessions at 106.6 F. (41.4 C.) with promin during 18 hours before fever.

Patients receiving 8-hour sessions of fever alone: This group comprises nine patients. Only one patient was bacteriologically negative following a single eight-hour session at 106.6 F. (41.4 C.). The number of treatments required to effect cure in this group averaged 2.4. Although considerably better than the average of 4.8 five-hour sessions during the pre-sulfanilamide era[5a] this plan of treatment did not appear to possess the merit of the longer 10-hour sessions and was abandoned in favor of the latter.

Patients receiving 10-hour sessions of fever alone: The treatment in this group followed the same plan as that just described except that ten hours instead of eight hours of fever at 106.6 F. (41.4 C.) were given. Of the sixteen patients included in this group, ten (62.5 per cent) recovered from the infection after a single ten-hour session at 106.6 F. (41.4 C.). The average number of such treatments required to effect cure was 1.56.

Patients receiving 10-hour sessions of fever combined with oral sulfanilamide during 18 hours before fever: Since it had been shown[12] that in the presence of a 1:10,000 concentration of sulfanilamide, the thermal death time of a given strain of gonococcus was lowered approximately 50 per cent, an attempt was made in this group to apply this *in vitro* finding to *in vivo* conditions by the application of artificial fever at a time when a 1:10,000 concentration (10 mg. per 100 cc.) of sulfanilamide was present in the body.

This group consisted of twenty unselected patients, of the same type as that comprising the preceding series. The sulfanilamide was administered according to the following schedule: At 2:00 P. M. on the day preceding the

* All records refer only to rectal temperature, as determined by continuously operating electrical indicating thermometers.

long fever session, the patient received an initial dose of sulfanilamide of 80 grains for individuals weighing over 150 or 60 grains for those weighing less. Thereafter, at intervals of four hours, maintenance doses, each of 20 grains, were given. In this manner, a total of either 140 or 160 grains of the drug was administered over an eighteen hour period preceding the 10-hour session. At 7:00 o'clock of the morning following institution of sulfanilamide therapy, a ten-hour session of fever at 106.6 F. (41.4 C.) was begun. No additional sulfanilamide was given. The blood sulfanilamide concentration, as determined by the method of Marshall[13] or more recently by that of Bratton and Marshall,[14] as adapted to the Sheard-Sanford "photelometer,"[15] averaged 12 mg. per 100 cc. at the time the patient was placed in the cabinet and 8 mg. per 100 cc. at the conclusion of the session. It may be assumed, therefore, that a 1:10,000 concentration of sulfanilamide was present in the tissues for at least the greater part of the ten hours.

Of the twenty patients included in this group, not one demonstrated clinical or bacteriologic evidence of gonococcic infection after a single 10-hour session at 106.6 (41.4 C.). This would seem to confirm the conclusion of Wengatz and his co-workers[12] regarding the effect of sulfanilamide on the thermal death time of the gonococcus.

From the practical standpoint, we were not satisfied with this therapeutic program. The amount of sulfanilamide given during this eighteen-hour period appeared to have a definite influence on the patient's reactions during the treatment. The actual amount of fever administered was the same as that given to those patients who had received no sulfanilamide. Any changes exhibited by the patient, therefore, could reasonably be attributed solely to the drug. The known tendency of sulfanilamide to produce dizziness, headache, mild mental confusion and delirium was definitely exaggerated at a temperature of 106.6 F. (51.4 C.). For this reason primarily, without denying that such a combined form of chemical and fever treatment was highly effective, a method was sought to attain the same result without the presence of these annoying and potentially dangerous side-complications.

Patients receiving sulfanilamide administered intravenously immediately preceding a 10-hour session of fever: Sixteen patients are included in this group. The schedule of sulfanilamide dosage was as follows: One hour before the 10-hour fever session, sulfanilamide was given intravenously in the form of an 0.8 per cent solution (in physiologic salt solution), the dosage being calculated on the basis of three-fourths of one grain of sulfanilamide per pound of body weight.. Such a dosage was sufficient to produce blood sulfanilamide concentrations of 10 mg. or more per 100 cc. for the duration of the fever treatment. The administration of the drug one hour before the fever treatment was thought to allow sufficient time for its uniform distribution throughout the fluids of the body.[16]

From the practical standpoint, such a program appeared to remove the difficulties inherent in the oral method of administration of the drug. Toxic reactions were strikingly diminished and in many patients completely absent. Since the amount of fever administered to the two groups was exactly the same, the type of patient was the same, and the blood sulfanilamide concentrations were practically identical in the two groups, we anticipated that the therapeutic results would be comparable. This did not prove to be the case.

Of these sixteen patients, only thirteen were cured by a single 10-hour session of fever combined with sulfanilamide given intravenously one hour prior to the beginning of the fever treatment. Even with due regard for the small number of patients included in either group, one is forced to the conclusion that the mere presence of sulfanilamide in a 1:10,000 concentration does not

wholly explain its therapeutic action. The *in vitro* experiments of Wengatz and co-workers, cannot, therefore, be translated directly to *in vivo* conditions.

Patients receiving 10-hour sessions of fever combined with promin: Promin,* the sodium salt of p,p'diaminodiphenylsulfone-N,N'-di (dextrose sulfonate), was administered to this group of patients because of its extreme solubility. It is prepared as a stable 40 per cent solution which is suitable for parenteral injection. Because of this ready solubility, it was thought that diffusion through the body fluids might be more rapid and complete than is the case with sulfanilamide. Promin, in 75-grain quantities, was injected intramuscularly four times during the course of the 10-hour session of fever. This quantity was sufficient to maintain a promin level in the blood of 10 to 15 mg. per 100 cc. for the duration of the treatment.

Despite the large amount of this preparation, none of the signs of toxicity commonly observed following the oral administration of sulfanilamide were noted. Of the 11 patients subjected to this program, only 7 were cured after a single 10-hour session of fever. There did not, therefore, appear to be any advantage in this combination of fever and chemotherapy over fever therapy alone.

Patients receiving 10-hour sessions combined with promin during 18 hours before fever: The results of the experiments given above appeared to demonstrate that the therapeutic efficacy of sulfanilamide is increased if this drug is administered for a period prior to the fever session. This experiment was designed to test the possibility of a similar increase in the therapeutic effectiveness of promin, given for a similar period prior to fever.

Beginning at 2:00 o'clock on the afternoon preceding the long treatment and at intervals of 4 hours thereafter, 75-grain injections of promin were given for a total of 5 doses. None was given during the fever session.

Signs of toxicity due to chemotherapy in this group of patients were minimal. Nearly all of these individua's exhibited the same type of approximately the same amount of "cyanosis" as noted in those receiving sulfanilamide by mouth. Headache, nausea, dizziness, confusion, and delirium were not encountered. Of special interest was the almost complete absence of the post-fever depression customarily seen the day after the long treatment session in those individuals who received sulfanilamide.

The therapeutic efficacy of this type of treatment, as measured by cure following the single session of 10 hours of fever at 106.6 F. (41.4 C.), compares favorably with that noted in group 2 (a). All of the 11 patients in this group were cured following the single long treatment. If this high degree of therapeutic efficacy can be maintained, it would appear that this combination of methods is the treatment of choice.

Conclusions

1. Eighty-three patients suffering from complications of gonorrhea, resistant or intolerant to chemotherapy, have been treated with artificial fever, either alone or combined with chemotherapy.

2. Of 25 refractory patients receiving fever therapy alone, only 12.5 per cent were cured after a single 8-hour treatment at 106.6 F. (41.4 C.); 62.5 per cent were cured after a single 10-hour treatment at 106.6 F. (41.4 C.).

3. When combined with artificial fever, the effectiveness of chemotherapy (sulfanilamide or promin) is influenced by the time-dosage relationship with respect to the fever treatment.

4. All of 31 unselected patients treated with chemotherapy for 18 hours before a single 10-hour fever session at 106.6 F. (41.4 C.) were cured.

* Promin was supplied for investigative purposes by Dr. E. A. Sharp, Director of Clinical Investigation, Parke-Davis & Company.

5. Rigid bacteriologic criteria were employed as the chief basis for the determination of cure.

6. A single 10-hour session of artificial fever combined with adequate chemotherapy for an 18-hour period prior to the fever treatment appears to be the procedure of choice in the management of chemotherapy-resistant gonococcic infections.

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(g) Desjardins, A. U.; Popp, W. C., and Stuhler, L. G.: Fever Therapy for Gonococcic Infections, Med. Clin. North America **21**:685 (May) 1937;

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(b). Lovelace, W. R.: Oxygen for Therapy and Aviation: An Apparatus for the Administration of Oxygen or Oxygen and Helium by Inhalation, ibid **13**:646 (Oct. 12) 1938;

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Discussion

Dr. Donald L. Rose (Dayton, Ohio): Dr. Kendell has made three significant observations. First, with respect to gonococcic infections, there appears to be no correlation between chemoresistance and thermoresistance. This strongly suggests the possibility that the mechanism by which favorable therapeutic response is effected is wholly different in these two modes of management. Second, the combination of artificial fever and chemotherapy is more effective than either agency alone. Finally, the effectiveness of this combined form of therapy is definitely enhanced by the continuous administration of the chemical agent for a period preceding the fever treatment itself. It would thus appear that the effect by which drug action manifests itself is a delayed one, a mechanism requiring time to set into motion. From thermal death time studies we have long known that the action of fever also appears to be a delayed one. To obtain the full value of this combined form of treatment, therefore, it is necessary to take advantage of these peculiarities inherent in these two modes of therapy.

While we are fully aware of the possibility that no doubt there are gonococcic infections which would be refractory to the type of therapy outlined by the essayist, the apparent clear-cut uniformity in the results obtained by this method suggests that we are well beyond the minimal effective dose of either fever therapy or chemotherapy or both agencies. Accordingly, we have projected an experimental series of groups of patients subjected to gradually decreasing quantities of both fever and drugs, hoping thus to attain a level beyond which the therapeutic response is definitely inferior to that noted in this paper. The first attempt in this direction has been accomplished. To a group of 18 chemotherapy-refractory patients, promin was administered for a period of 18 hours preceding a ten-hour session of fever at 106 F. The therapeutic response in this group appears to be the same as that obtained at the higher and potentially more dangerous fever level of 106.6 F. The implications of this trend in treatment are obvious.

Dr. O. L. Huddleston (Denver, Colorado): As Dr. Kovács told you, Dr. Krusen was scheduled to give a radio address this afternoon, and the time conflicted with this discussion period. A few minutes ago he asked me to substitute for him. He left with me no paper or any written discussion. However, he did say that at his institution some seventy patients or more have been treated with the combined chemotherapy method, and that the results are essentially similar to those obtained at the laboratory at Dayton. He wishes also to emphasize that even with the improvement in the method of administration of fever therapy, it is still an institutional procedure, and that any patients should be sent to an institution, hospitalized, and the treatment administered under the direction of personnel specially trained in this field.

Now with the advance of fever therapy and the improvement in results and technic, there are still considerable dangers in the method. We know that there may occur circulatory collapse, shock, and the like. The patients must be more or less carefully selected and prepared for this procedure. So Dr. Krusen asked that the message be emphasized, that fever therapy is still an institutional procedure and that due caution should be maintained in treating the patients, even though better results may be obtained with combined chemotherapy and fever therapy.

This is indeed an interesting subject, because it rather opens a new field of endeavor. For a number of years, pharmacologists have been studying the effects of drugs. Many laboratories throughout the country have made thousands of experiments to find out the action and effects of drugs on normal and abnormal tissues. To date not so much along that

line has been done with physical agents, but we are beginning to see results in many researches in this field. This field, in which the combined action of drugs and physical agents upon diseased mechanisms is a new one, lends itself to many therapeutic advances, if applied to other fields, that we may look forward to considerable progress when we extend the combination of physical agents and efficient drug therapy to the management of other diseases.

Dr. William Bierman (New York): The only patients we see nowadays who are suffering from gonorrhea are those who have proved failures when treated by sulfanilamide or any of its compounds. In private practice we cannot, unfortunately, approach them with the same experimental attitude that the author of the paper and the first discussor have described. That unquestionably is the method of choice.

Thus far, on a much smaller series of cases, we have been successful in securing a complete disappearance of the organism in all the sulfanilamide and sulfapyridine cases we have seen, by a single treatment of longer duration. In private practice, when the practitioner tells you about his patient, who has failed with sulfapyridine and sulfanilamide, and who has developed these symptoms, you are in a position where, though you might like to combine the two, you are forced to use fever alone. That has been my position. Fortunately, every one of the private cases I have thus far treated has been cured. One hundred per cent results are not too good. Sooner or later we expect failure, but we have observed, as the second speaker has mentioned, that failure with the drug does not necessarily mean the possibility of failure with the thermal procedure which we have used.

Dr. Isadore Levin (Washington, D. C.): I would like to ask the essayists whether they have had any cases they have given these long treaments with sulfanilamide, which have developed jaundice afterwards; also if they have had any cases that showed failure of the peripheral circulation afterwards, where they could not feel the radial pulse, but the patient seemed to be otherwise in good condition.

Dr. H. Worley Kendell (closing): I want to thank the discussants for their constructive remarks, particularly Dr. Bierman, who has had wide experience with the administration of artificial fever. I quite agree with him that all cases resistant to sulfanilamide or allied drugs can be cured with fever therapy alone, but we have tried to consider that possibly by less amounts of fever combined with chemotherapy, the procedure may be rendered less complicated.

I want to emphasize what Dr. Huddleston has stated—that this procedure should be carried out in an institution. I did not have sufficient time to discuss laboratory work that has been carried out in this group of patients, which I feel has been an important study and guide. We have undertaken detailed laboratory studies on all these patients, which will be reported at a later date.

In regard to Dr. Levin's question about jaundice, we have not observed any clinical jaundice in our group of patients. We have, however, observed jaundice in patients receiving chemotherapy alone. We would be somewhat reluctant to take that group of patients and subject them to fever therapy combined with high concentrations of drugs. We have had several who were reported to us by their physicians as having had mild jaundice during the course of chemotherapy. They have been subjected to fever treatment without complications. We have tried to check routinely the icterus index beginning the day after treatment was given. If this was elevated, intravenous sodium chloride and glucose solutions were administered. I hope next year, if we can continue with this work, we may have something still further to offer in the application of this combined method of treatment, not only in gonococcic infections but possibly in other diseases.

ARCHIVES of PHYSICAL THERAPY
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.·. EDITORIALS .·.

PROFESSOR D'ARSONVAL, VALE!

The news of the recent demise of Professor Arsène d'Arsonval in his house and laboratory at Nogent-sur-Marne in occupied France comes as a shock to all to whom the name of this illustrious savant is known, even though his advanced age and failing health should have forewarned the scientific world about the great loss it was about to sustain.

D'Arsonval was a typical French scientist, intensely patriotic, devoted to his life's work, but in some respects he differed from the run of academicians in his country who were and are not averse to seeking the plaudits of the people. Of him rightly it may be said that he was science personified—concrete, exact and impersonal. Though d'Arsonval the man was a devoted husband, an affectionate kinsman, and a staunch friend of all he had learned to admire and respect, d'Arsonval the scientist lived in a world of his own—the laboratory. His inventive genius was such that he could have earned enormous sums for certain of his discoveries that still are being utilized in the industries; but not unlike Pasteur he gave them all to science as its devout priest. He sought no honors, but they were heaped upon him by governments, nations, learned bodies and institutions. He accepted them not for himself but as recognition of the great school in which he held the chair of electrophysiology, electrophysics and electrochemistry for a generation. Even after his compulsory retirement, he continued his labors without interruption in the laboratory given him by the nation, with the official title "honorary" being decreed for his professorial rank.

Medicine, especially physical therapy, owes an eternal debt of gratitude to his genius. Though the treatment of diseases by physical means dates back to the hoary past and electrotherapy has been practiced long before d'Arsonval, the scientific application of high frequency currents in surgical as well as internal affections was made possible solely by his ingenious experiments and, what is even more important, his demonstrations on living beings. When it is realized that an energy sufficiently intense to kill the largest and most powerful animal in a second or two was modulated by him until it became transformed into a harmless and beneficial agent for the production of endogenous heat within tissues in contrast to the available but less effective means for the application of exogenous heat, then one must admit that if d'Arsonval had made no other discovery his name would still go down in the history of medicine alongside with those of Harvey, Pasteur, Lister, Koch and others, whose labors have revolutionized the healing art. Nor should it be overlooked that no matter what modifications, perfections and innovations have already been attained and no doubt will yet be achieved in the future, it was he who was their first creator or founder, and every superstructure can only redound to his credit and glory.

A man is supposed to have lived long if he has reached the Biblical three score and ten years, but it is almost over such a long period that d'Arsonval has labored in the temple of science incessantly, with barely enough of interruptions to obtain mental and physical relaxation. This longevity was a gift of fate, but what was solely his own achievement is the fact that dur-

ing that long period every one of his many and manifold undertakings was started with a definite aim and not one had to be discarded as a failure.

There is available not only an extensive biography but many detailed accounts of d'Arsonval's life and labors, so that another recital of his great achievements would be merely a repetition of what is or should be known to all interested in electrobiology and especially electrotherapy. There have been other great men in medicine who by their unselfish labors have benefited humanity, but few have a record of d'Arsonval's longevity, tenacity in pursuing many goals and—attaining them.

Years ago France has formally pronounced him to be one of her immortals. But his lustre is such that even without such formal recognition by his illustrious confrères his name will be kept alive as long as there will be disease and suffering in the human race and a science and art of medicine.

CORRESPONDENCE

Re: Short Wave Dosimetry

To the Editor: In view of two recently published articles in the ARCHIVES[1, 2] I should appreciate the courtesy of space for a few remarks in your journal. They may prove helpful in clearing up some misunderstandings in connection with my "dosimeter" or "high frequency wattmeter" for measurement of the power absorbed by the patient under short wave treatment. These misunderstandings are possibly due to an incorrectly used terminology. A restatement and clarification of some terms and definitions therefore seem desirable.

In both articles the expressions "dosimeter" and "dosimetry" are used in a sense, which by implication could be better interpreted as "prescriptionmeter." According to the dictionary and as a matter of fact, to the everyday use in every other field of science and medicine, the word *dose* merely means a quantity of anything which can be measured. In drug therapy it is the amount or portion of medicine to be taken at once, in x-ray therapy the quantity of x-ray radiation administered. In this—and only correct—sense every instrument which measures such quantities can be referred to as a "dosimeter," as for instance the scale of the pharmacist or the radiation meter of the radiologist. By performing such quantitative measurements these instruments or "dosimeters" do exactly what every instrument does: they register facts. Their reliability and usefulness depend upon whether they indicate the facts correctly and in a way that makes their indications accessible to an inteiligent interpretation. Certainly no instrument will convey the knowledge how to write a prescription or how to use an x-ray machine, or for that matter, how to draw the proper conclusion from the correctly presented facts. This is only possible by the use of proper judgment, clinical judgment if you like, based upon training and experience, and last but not least upon an adequate knowledge of the properties and behavior of the used agents.

However, for some reason or another, this very impossibility is sometimes expected of an instrument in short wave diathermy, or at least the tacit though perhaps unintentional implication is made that it was or should be designed for such a purpose. For obvious reasons no instrument in any field, be it in engineering, medicine or physics, can perform such substitutions of a well trained mind. It is for this reason that everybody will agree with Dr. Schmitt when he says that clinical judgment is an absolute necessity in the determination of dosage. But this very clinical judgment, or the drawing of the proper conclusions—because that is what it amounts to—is made possible only through the reliable and correct presentation of the facts by a suitable instrument. This is true, whether it concerns the amount of a drug or the power of absorption in short wave diathermy. Without such knowledge of the facts there are no premises from which conclusions could be drawn, and instead of utilizing clinical or any other judgment, we are limited to guesswork because we literally do not know what is going on.

"Dosage" on the other hand is a procedure, including the processes of selecting, measuring and administering the proper dose. If we adhere to this interpretation and definition of the dictionaries, then expressions like "dosage meters" and dosage measurements" are misnomers bound to lead to misinterpretation. They are sometimes obviously used in analogy to the expressions voltage, amperage, wattage in electrical engineering, where these expres-

1. Molander, C. O.: Technic in Short Wave Therapy, Arch. Phys. Therapy **21**:615 (Oct.) 1940.
2. Schmitt, Milton G.: Optimal Dosage in Short Wave Diathermy, Arch. Phys. Therapy **21**:716 (Dec.) 1940.

sions denote the amount of electrical tension, current and power measured in volts, amperes and watts respectively. It was in this sense that I used the term dosage in the title of an original article. [Mittelmann, Eugene, and Kobak, Disraeli: Dosage Measurement in Short Wave Diathermy, Arch. Phys. Therapy **19**:725 (Nov.) 1938.] I sincerely regret it, because the choice of the word was certainly an unfortunate one.

I hope this brief explanation will help to clarify the issue. This ought to be the easier, as there is no disagreement about the fact what my instrument does, rather a misunderstanding only about what it is supposed to do. It measures correctly the amount of calories per second supplied to the patient by the short wave generator in the form of high frequency energy. Or, which is identical, it measures the number of watts actually absorbed by the patient. In other words, it measures any arbitrary "dose" which the physician might choose to select. The determination of dosage, or the decision what dose should be administered, how long and how often, is possible only after proper diagnosis by the physician. It is obvious that he must rely on his clinical judgment. Even the most intricate instrument will merely aid him in arriving at the right conclusion, but will not relieve him of his clinical responsibility. I think there can be no disagreement about that.

EUGENE MITTELMANN,
Department Physical Therapy,
Northwestern University Medical School.

Re: Infra-Red Action

To the Editor:

In the December, 1940, issue of the ARCHIVES is an article on "Infra-Red Heating Over Taped Surfaces," in which the author writes: "the non-penetrating infra-red radiation is not reflected and is completely absorbed at the skin surface." He continues: "If white adhesive tape, is placed on the skin, the point of radiant energy reflected will be greater than for skin alone; therefore, there will be less energy available for heating of the underlying tissues. This is more marked for the penetrating than for the non-penetrating infra-red radiation, because the reflection of the latter is much less in both conditions."

Grotthus formulated the generally accepted law that "only the rays which are absorbed are physiologically active"; I would like to know how the author differentiates between penetration and absorption of "penetrant" or luminous infra-red radiation (from tungsten filament bulb) and non-penetration yet absorption of "non-penetrant" or non-luminous infra-red radiation (from resistance coil type of infra-red generator).

JOSEPH E. G. WADDINGTON, M.D.

Reply to Dr. Waddington's Question

No attempt has been made by the author to differentiate between "penetration and absorption vs. non-penetration yet absorption." On the contrary it was stated: " . . . we have no data regarding the amount of heat reaching the subcutaneous tissue and hence we are not justified in reaching any conclusion as to which source of infra-red radiation is the most efficient for this purpose." However in the reported study two different sources of infra-red radiation were compared and some of the known facts regarding the relative absorption from these sources were quoted.

BEN L. BOYNTON, M.D.

A Bread Revolution. Jane Stafford.

Sci. News Letter **39**:26 (Jan. 11) 1941.

According to Jane Stafford we are on the eve of a food revolution. It will strike the average American home at the breakfast table some morning soon. The new vitaminized flour will give modern Americans strength for defense in war. It will add strength to cope with the problems of modern civilized life which threatens as ominously as war itself.

Flour, wheat flour or white flour, legally in the United States today is "the fine ground product obtained in the commercial milling of wheat consisting essentially of the starch and gluten of the endisperm. It contains not more than 15 per cent of moisture, not less than 1 per cent of nitrogen, nor more than 1 per cent of ash, and not less than 0.5 per cent of fiber." Tomorrow this may still be the legal definition for white flour in the United States. It will not, however, be the legal definition for all white flour. Legally, there will be a new wheat flour, with a new name.

Vitamin starvation makes people sick, not hungry. People starved for vitamin C, the vitamin found in citrus fruits, tomatoes and cabbages, for example, get the sickness known as scurvy. Oriental people living on a diet consisting almost entirely on polished rice got a strange disease called beriberi. They were starved for a vitamin found in the outer, branny coat of the rice kernel. This vitamin was originally labeled vitamin B, and anti-beriberi vitamin.

Wheat, from which most of our flour and bread is made, contains the anti-beriberi vitamin, known chemically as thiamin. It also contains other vitamins, known collectively as the vitamin B complex, and certain minerals. When wheat is ground in modern mills to make fine, long-keeping, pure white flour, 80 to 90 per cent of the thiamin, and in addition a good portion of the other B vitamins and of minerals, are removed with the bran, as they are when rice is polished to shiny whiteness.

One of the newest pieces of knowledge about vitamins is the evidence that thiamin, the old vitamin B, should change its alias into "anti-beriberi vitamin" to "morale vitamin." This is one of the vitamins that will be put into the new bread and flour.

The evidence that gives thiamin a right to the new name of morale vitamin came from diet experiments at the Mayo Clinic. A group of healthy young people were put on a diet otherwise ade-

(Concluded on page 118)

SCIENCE, NEWS, COMMENTS

New York Physical Therapy Society

The New York Physical Therapy Society will hold its stated meeting, Wednesday, February 5, 1041, at 8:30 p. m., at the New York Academy of Medicine Building, 2 East 103rd Street, New York, N. Y.

The following program is planned:

I. Scientific Session:

1. Chronaxy, Description, Review of Literature and Demonstration (lantern slides). *Sidney Licht*, M.D.

Discussion opened by *Henri Laugier*, M.D., and Dr. *Vladimir*, of Paris (by invitation).

2. Electromyographic Studies (lantern slides). *K. G. Hansson*, M.D.; *B. S. Troedsson*, M.D., and *Erich Schwartzkopf*, Ph.D., (by invitation.).

Discussion opened by *A. T. Milhorat*, M.D., and *A. A. Schnier*, M.D. (by invitation).

All physicians are welcomed.

II. Executive session.

LEWIS J. SILVERS, M.D.,
President,
64 East 87th Street, New York, N. Y.
MADGE C. L. MCGUINNESS, M.D.,
Secretary,
1211 Madison Ave., New York, N. Y.

Meeting of the Section on Physical Therapy, Medical Society of the County of Kings

The next regular meeting of the Section on Physical Therapy of the Medical Society of the County of Kings will be held in the Kings County Medical Society Building, 1313 Bedford Avenue, Brooklyn, N. Y., Thursday, March 13, 1941, 8:30 p. m. sharp. The following program will be presented:

1. Use of Ultraviolet Rays in Dermatology, *M. E. Goebel*, M.D., Kings County Hospital;

2. Physical Therapy Measures in Dermatology and Resumé, *Richard Kovács*, M.D., Polyclinic Medical School and Hospital.

Dr. McGuinness Honored by Medical Society of the County of New York

Dr. Madge C. L. McGuinness has been appointed as Chairman of the Special Committee on Physical Therapy of the Medical Society of the County of New York by Dr. Alfred M. Hellman, President. The personnel of the Committee is as follows:

Lionel S. Auster, M.D.; William Bierman, M.D.; David C. Bull, M.D.; Anthony C. Cipollaro, M.D.; A. Bern Hirsh, M.D.; Richard Kovács, M.D.; John Oberwager, M.D.; David Sackin, M.D.; Norman E. Titus, M.D., and Leslie P. Barker, M.D.

American Physiotherapy Association 20th Annual Convention

The American Physiotherapy Association will hold its Twentieth Annual Convention at Asilomar, California, from July 13th to July 18th, 1941.

Officers and members of the American Congress of Physical Therapy are cordially invited to attend.

Glycerine Made Synthetically Expected to Stabilize Price

Synthetic glycerine, a product long sought in vain by chemical industry, is now available from petroleum. Recent technical reports to the American Chemical Society by Dr. Evan C. Williams, Dr. H. P. A. Groll and G. Hearne, of the Shell Development Company, Emeryville, Calif., show how unlimited quantities of the compound can be made from cracked gasoline.

Glycerol, as the chemist prefers to call glycerine to show its family relation to alcohol, has ever been the victim of fickle market conditions, since it is a byproduct of rather fixed quantity from the soap industry. A change in demand, as occasioned by war conditions or peace treaty, does not affect supply and thus prices skyrocket and dive most inconveniently. Figures from 9 to 70 cents per pound have been quoted since the World War. During the one year 1938 the price dropped nearly 60 per cent.

Although glycerol is a simple organic compound, its molecular structure, with one atom of oxygen attached to each carbon atom, has baffled the synthetic manufacturer who must use processes of low cost. By allowing chlorine to react upon propylene, a gaseous component of cracked petroleum, the California technologists have succeeded in producing at low cost the substance allyl chloride. From allyl chloride the compound trichloropropane is then readily prepared. The molecule of trichloropropane is similar in structural design to that of glycerol, and the product is readily convertible into glycerol with the aid of cheap alkali.

The new synthetic glycerol has been tested in gross quantities in the stomach, with effects even less unpleasant than those from the pharmaceutical grade of natural glycerol. Being identical in composition, the preparation needs attention only to purity standards, and this question is easily solved.

It is suspected that much more of interest is in view than a mere stabilization of price and strategic war supply for use in a possible time of siege.

By combination of glycerol with acids, a remarkable array of valuable oils is possible. These compounds are analogous chemically to olive, cotton and linseed oils, but without the narrow restrictions in quality and quantity imposed by nature in plant growth.

From petroleum it is likely that entirely new acids, perhaps those with molecules in bunch-like form instead of the chain form normally followed by plants and animals, may be available for this field of research. From such syntheses it is possible that lubricants superior to castor oil, and paint vehicles ahead of linseed oil, might be discovered. The castor and linseed products are glycerol-acid compounds of the type in question. Furthermore, the resin industry is interested in the prospects of cheap glycerol, which with complex acids forms very complex derivatives for use as plastic resins. — *Science News Letter.*

Museum of Health Vouches for These Health Facts

Health facts authenticated by American Museum of Health exhibits: An area about the size of a penny on each side of your nose allows you to smell. The normal human ear is capable of receiving sound waves of 16 to 16,384 vibrations per second. The average healthy grown person's body has 25,000,000,000,000 red blood corpuscles, 30,000,000,000 white corpulscles and 1,250,000,000,000 platelets. The human skeleton has 245 bones. Swimming develops your lung capacity more than any other activity. The typical person breathes 7.03 quarts of air per minute while resting flat on the back, 45.46 quarts while swimming. — *Science News Letter.*

Phenothiazine Found Useful in Veterinary Medicine

A chemical related to sulfanilamide, known as phenothiazine, has been found highly effective in the treatment of several species of parasitic worms in livestock by scientists of the U. S. Department of Agriculture. As soon as manufacturers make suitable application to the Secretary of Agriculture, it will be released as an accepted veterinary medicine.

Phenothiazine first came into scientific notice half-a-dozen years ago when it was found to be highly toxic to insects and very slightly so to warm-blooded animals. This original research was carried out by L. E. Smith of the Bureau of Entomology and Plant Quarantine. Investigations since then have led Department of Agriculture scientists to believe that it is one of the most versatile chemicals brought to light in recent years.

In addition to its effectiveness against insects, worms and other cold-blooded forms of life, phenothiazine has been found to have marked fungicidal and bactericidal properties. In the latter field, it has been used as an internal antiseptic in human medicine, in the treatment of cystitis, pyelitis and allied diseases.

Researches on the use of phenothiazine in human medicine have been conducted by Dr. Floyd DeEds of the Stanford University School of Medicine, to whom a public service patent on this phase of its applications has been granted. — *Science News Letter.*

New K Vitamins Better

Better results in checking dangerous bleeding with vitamin K are promised by new, synthetic K vitamins announced by Drs. E. A. Doisy, S. B. Binkley, S. A. Thayer, R. W. McKee and D. Richert, of St. Louis University.

The new anti-bleeding chemicals related to vitamin K can be dissolved in water, whereas natural vitamin K compounds cannot. This means that the natural K vitamins must be taken by mouth, but sometimes the patients needing the vitamin most are so sick they cannot take anything by mouth. The new, water-soluble K vitamins can be injected by hypodermic needle in such cases.

The natural vitamin K_1 has previously been isolated and synthesized by Dr. Doisy and associates and they told also about the chemical structure of another natural anti-bleeding compound, vitamin K_2. — *Science News Letter.*

Dangerous Bleeding Stopped By New Thrombin Preparation

Bleeders, from new-born babies to patients on the operating tables and even, in many cases, hemophiliacs suffering from the hereditary bleeding disease, can now be saved by two death-defeating substances presented by Dr. H. P. Smith, State University of Iowa, at the meeting of the Federation of American Societies for Experimental Biology in New Orleans.

One of the anti-bleeding substances is a new preparation so powerful that when sprinkled on a wound it stops bleeding by clotting the blood "in the twinkling of an eye." It is obtained from beef blood at the slaughter house which, after preliminary treatment, is whirled in an apparatus like a cream separator. The fluid that separates out, called blood plasma, is diluted with water, treated with acid and other chemicals to purify it and finally sterilized by filtering through cakes of ground glass partially fused together.

This material is so fast in action it will clot blood in one second. It is not yet on the market and the supply is still limited but surgeons at the University of Iowa have already used it, with "quite encouraging" results, to stop dangerous oozing of blood during major operations. This oozing, which is difficult if not impossible to stop by other methods, is especially troublesome in operations on the brain, liver and bone.

When the material is available generally, dentists will also be able to use it to stop bleeding after teeth are drawn. For hemophiliacs, like the Spanish Count of Cavodonga, who recently bled to death from injuries following an automobile accident, the new thrombin may prove life-saving. It cannot stop the internal bleeding, but in many cases hemophiliacs bleed to death from cuts on the surface of their bodies. This bleeding can be stopped by the new thrombin.

Thousands of new-born babies and older patients suffering from obstructive jaundice can be saved from bleeding to death by the other substance Dr. Smith discussed, vitamin K. This vitamin not only

stops bleeding but if used properly will prevent the bleeding, Dr. Smith emphasized.

The vitamin was discovered by Prof. H. Dam of Copenhagen. Its chemical identity was determined and it was prepared synthetically by scientists at the St. Louis University and the University of California. It was first used to treat patients by Dr. Smith and by doctors at the Mayo Clinic.

A "bedside" test for determining when to use vitamin K to prevent bleeding was described by Dr. Smith. He urged doctors to use this test on patients who might bleed, so that the vitamin can be given in time to prevent the bleeding. For newborn babies, one out of every two or three hundred of whom are in danger of bleeding, vitamin K can be given during the first few days of life. The second to the fourth days are the danger periods for these babies. Doctors at Johns Hopkins Hospital in Baltimore, in Virginia and in New York, Dr. Smith said, are giving the vitamin to the mothers before the babies are born, to prevent the bleeding in the babies.—*Science News Letter.*

Electric Shock Therapy Given First U. S. Trials

Electric shock therapy, a method of treating mental disease by passing an electric current directly through the brain, was introduced in the United States.

The ink blot test, familiar as a measure of imagination, was used successfully to predict which mental patients would respond to the new insulin shock treatment, and to distinguish neurotics from those with uncomplicated mental disease.

Actual measurement of how an individual behaves when approaching a nervous breakdown was made possible by a new technic developed in experiments with animals.

The Stanford Binet, familiar test for measuring intelligence, can be adapted to detect early stages of mental disease, it was reported.

Abnormally slow brain waves, rare in normal children, were found to be relatively common among problem children.

Brain waves were put to practical use in the rejection of would-be pilots found to have brain waves believed characteristic of epilepsy.

Strychnine dropped into the eyes was found to improve vision impaired at high altitudes, indicating that the narrowed field of vision of a person suffering oxygen deprivation is a matter of eyesight rather than mere attention.

With a special pneumatic grip on the control stick, it was found possible to measure the tenseness of student pilots while making various maneuvers during flight, take-off and landing; overtense individuals make poor students, it was found.

Lights flashing in the eye were found to produce electric waves in the brain (not the brain waves originating there) so sharply localized that it was possible to map the area governing vision by electroplotting the exact position where the signals could be picked up.

Learning ordinarily requiring the important temporal area of the brain's cortex can take place subcortically, it was demonstrated when the temporal area in animals was either rendered useless by the drug curare or completely removed.

Airsickness, which can be produced in the laboratory by mild electric shock through the ears, can also be produced by "conditioning" it was found when simultaneous ringing of a bell with the shock taught individuals to sway or fall over when later they heard the bell alone.

Theories of learning were affected by discovery that an individual conditioned in deep hypnotic sleep by smelling creosote during the ringing of a bell will afterwards in waking state have a vivid image of the odor of creosote whenever he hears that bell, and without any remembered associations.

Learning by organizing material in close connection with the situation was demonstrated to be more efficient and subject to transfer than ordinary rote memorizing or verbal generalizing.

All individuals, regardless of age, sex, or state of mind are equally sensitive to pain, it was discovered by a new technic which opens the door to new laboratory experiments on the effects of pain-relieving drugs.

Hunger does not exist as a single manifestation, it was found; instead there are at least 10 specific hungers: for protein, fat, carbohydrate, water, oxygen, salt, phosphorus, sodium, calcium and the vitamin B complex.

The span of visual attention, that is the number of dots that can be seen in a fraction of a second, was shown to depend on the exposure time and the light intensity; the shorter the exposure time, the greater is the light intensity required.

The excitability of the visual receptor was found to be cyclic, even with constant stimulation; at the end of the cycle the receptor discharges, and thereafter requires recovery during another cycle before it discharges again.

When a uniform area of the eye is stimulated by light, it was found that there is greater nervous excitation near the center of the area than at the edges.

Sounds can be heard as coming from different directions, not only horizontally as has long been known, but also vertically, it was found, provided you turn your head while listening.

Color vision and ability to distinguish small differences of color were observed to be equally developed in man and in the chimpanzee, though man does somewhat better with the reds.

Monkeys without the important frontal lobes of their brains, were found able to use a combination of tools in a way previously considered exclusively human, but were unable to assemble the tools from different sides of the cage—a problem within their ability when they had the frontal lobes.

Five leading psychological organizations appointed representatives to cooperate with the National Research Council in making the services of psychologists available to the government in the present emergency.

A number of organizations became concerned with the psychological factors involved in morale; a conference of 25 psychologists discussed and reached an agreement concerning certain factors involved.

Public opinion polls reduced their average error between 2 and 3 per cent in predicting the outcome

of the November elections, thus establishing themselves with some security as perhaps the first technic in the social sciences to achieve scientific prediction of coming events.

A method was developed for classifying body types which may make it possible to solve certain long-standing problems of relation between development and bodily constitution.

Kills Cancerous Tumors

Hope that cancer may some day be more effectively treated by injecting distilled water into the diseased tissue after x-raying was held out by Drs. G. Failla and K. Sugiura of Memorial Hospital, New York City, in a report presented before the Academy.

Pronouncedly favorable results have been obtained in experimental work on mice. Nothing has yet been undertaken on human cancers, however; and Dr. Failla laid special emphasis on the fact that Memorial Hospital is not undertaking this treatment of human cases until much more experimentation can be carried out on mice.—*Science News Letter.*

Radioactive Indium Metal May Have Medical Uses

Three new forms of artificially radioactive indium, created by bombarding the rare metal with high-voltage x-rays, have been manufactured by a Massachusetts Institute of Technology research group.

The discovery, reported to the American Physical Society, confirmed the findings of Notre Dame physicists that high-voltage x-rays would produce radioactivity. The artificially activated indium made in that experiment had a half-life of four hours but M.I.T. scientists have uncovered a whole range of activities, from one with a half-life of 4 hours to one with a half-life period of only 12 seconds.

Substances with short half-life periods are expected to be very valuable in the medical applications of these substances.

The report was an unprogramed supplement to a scientific paper on the high-voltage production of positive ion and electron beams with the M.I.T. giant electrostatic generator. The research was done by Dr. Robert J. Van de Graaff, Dr. Lester C. Van Atta, Dr. Chester M. Van Atta and Doyle L. Northrup.

Evidence of the new activities was detected with the generator operating at a little under 1,000,000 volts, considerably lower than had been expected, and the yield mounted rapidly as the voltage was increased.

Indium is a rare metal with properties similar to aluminum. It is silver-white in color, softer than lead and about the same weight as tin. It is found chiefly in zinc sulphide or zinc blende ores.—*Science News Letter.*

Blood Grouping Shown On German Soldiers' Tags

Every German soldier has a new mark on his identification tag, around his neck, for use in case he becomes a casualty. In addition to name and outfit identification, the metal tag shows the soldier's blood group, saving valuable time in case a hurry-up blood transfusion is needed. Blood from a donor or bottled crimson fluid from a blood bank can thus be transfused without stopping to type the wounded man's blood. This information is from Berlin via American Medical Association. The Japanese army already does this.—*Science News Letter.*

Brain Operations Found to Aid Some Hopeless Mental Patients

New types of brain operations, in which parts of the brain's frontal lobes are removed, are causing astounding recoveries of cheerfulness and ability to cope with the problems of everyday living for some types of mental patients, Dr. J. F. Fulton of the Yale University School of Medicine told the Sigma Xi chapter of the Mayo Clinic.

Speaking on the functions of the brain's frontal lobes, Dr. Fulton said that the new surgical methods are being studied clinically and compared with the results secured by the severe "shocks" now given to some mental patients to lift them out of their mental state. Insulin and the drug metrazol have been tried for such shock treatment of the insane.

Dr. Fulton did not discuss the astounding change in personality for some patients following such operations, but one of the most amazing on record is the case of an unsuccessful stock broker who became a millionaire in a short while following the removal of a portion of the frontal part of his brain, where a tumor was present.

The ex-stock broker became a salesman and his success was so phenomenal that in a few weeks his company had to enlarge its plant to take care of his orders. Soon he was made a vice-president and is now in the millionaire class.

Such brain operations are made only as a last resort to save a patient's life or mentality.

From studies on animals and man, Dr. Fulton said in his address, scientists are now making great progress in what may be called the geography of the brain; a knowledge of what regions control what functions.

Just as the young of animals, including men, tend to repeat the whole forward cycle of their evolutionary background, it has now been found that the neurological processes of young animals also tend to exhibit throwbacks to their evolutionary ancestors.—*Science News Letter.*

Prostitution a Fifth Column

General Charles R. Reynolds, recently retired Surgeon General of the U. S. Army, warned against prostitution as a "fifth column in our midst" which threatens the new national defense army that will start for training camps shortly after the peacetime draft next week.

Syphilis and gonorrhea will attack the men in training camps unless prostitution, both commercial and clandestine, is controlled, General Reynolds warned. A plan for such control was given by General Reynolds before a special session of the American Public Health Association.

Outbreaks of syphilis and gonorrhea among the men on maneuvers near two southern cities last spring were immediate results of prostitution in those localities, General Reynolds reported. In one of the cities, among 85 prostitutes examined by health officers, one-third were found to have syphilis and one-half gonorrhea, and many had both.

Protection of the men against venereal diseases will be possible, he believes, because military and civil authorities will cooperate in this vital defense project and because of the "awakened public attitude toward this menace which provides an ally to the military forces which never before has been adequately mobilized."—*Science News Letter.*

Many Cases Diagnosed "Flu" May Actually Be Q Fever

Some persons in the United States who have had an attack of what appeared to be influenza or of a new and mysterious form of pneumonia may really have been infected with the rickettsia of Q fever, first described in Australia in 1937.

No germ has yet been identified as cause of these atypical pneumonia cases. A filtrable virus has been suspected but not yet proved to be the cause. The Q fever rickettsia is a filtrable germ that might be mistaken for a filtrable virus without careful tests.

Q fever and the atypical pneumonia are both mild ailments, not often fatal, and without x-ray examination of the patient's chest, either disease might readily be called influenza, rather than pneumonia. Neither, of course, is the same as influenza A, which is caused by a known virus.

Patients with Q fever with an atypical pneumonia have fever, rarely any chills, frequently profuse sweating. They feel ill and exhausted but do not have the breathing difficulty of typical pneumonia nor as severe body aches and pains as influenza.

"A comparison of the clinical features and physical findings in these cases," the National Institute's report of its Q fever epidemic concludes, "with various series reported from other sections of the United States in the past few years reveals suggestive similarities."

Q fever germs are kept at the National Institute of Health, but none of the persons handling these germs became ill. The 15 patients in the epidemic were working in scattered places throughout the building with no known contact with these germs. There is the possibility that they may have picked up the germs of Q fever outside the laboratory, which would make it more likely that there have been unrecognized cases of Q fever in the United States.—*Science News Letter.*

$1000 Prize Awarded to Vitamin Researchers

Discovery that humans need the part of vitamin B called riboflavin to keep them healthy and synthesis of another B vitamin, B_c, which has also been used successfully in treatment of humans, won the Mead, Johnson and Company $1000 award for advances in knowledge of the vitamin B complex at the meeting of the American Institute of Nutrition.

Recipients of the award are: Dr. W. H. Sebrell, National Institute of Health, U. S. Public Health Service, for the riboflavin discovery which has since led to discovery of the cause and cure of the sometimes blinding eye disease, keratitis; and, for the synthesis of B_c, a five-man research team of Merck and Company's research laboratories, Drs. John C. Keresztesey, Joseph R. Stevens, Stanton A. Harris, Eric T. Stiller and Karl Folkers.—*Science News Letter.*

A Bread Revolution — Stafford

(Continued from page 113)

quate, but lacking in thiamin. These healthy persons developed, among other symptoms, moodiness, sluggishness, fear, and mental and physical fatigue.

"The states of mind and body observed in these subjects," comments the editor of the *Journal of the American Medical Association*, "were such as would be least desirable in a population facing invasion, when maintenance of stamina, determination and hope may mean defeat or successful resistance."

Thiamin, the morale vitamin, and others of the vitamin B group are found in such foods as liver, lean meat, certain vegetables and yeast. Yeast has been suggested as one way of adding the vitamin to bread. Thiamin is obtained from a selected portion of the wheat germ obtained in the milling process and put back into the flour by another milling concern. This company also adds another of the B vitamins and the minerals, iron and calcium, to its flour. This flour has won the approval of the American Medical Association's council on foods.

The new flour and breads may be more nourishing than the old ones, but the flours, though not exactly adulterated, are not legally wheat or white flour. The Food and Drug Administration believes it can best serve and protect the public by creating a new definition for white flour-with-vitamins-and-minerals to which all millers can adhere.

The National Defense Advisory Commission, eager to build up the nation's man-power as well as its munitions, wants the people to have the benefit of flour restored to its ancient estate of vitamin and mineral richness. It cannot urge the use of enriched or fortified flours unless these contain enough of the right vitamins and minerals to bring real benefit. The National Defense Advisory Commission has turned to the scientists, requesting through Miss Harriet Elliot, Consumer Commissioner, formation of a committee of specialists to help determine how flour shall be modified to be a source of mental and physical stamina. Such a committee has been organized. This committee, the Food and Drug Administration and the millers are now drawing the blueprints for the new flour.

THE STUDENT'S LIBRARY

PHYSIKALISCH-DIÄTETISCHE THERAPIE NACH KLINISCHEN GESICHTSPUNKTEN. Von Dr. *Hans-Georg Scholtz*, Dirigierender Arzt der Abteilung für Physikalische Therapie am Städischen Rudolph-Virchow-Krankenhaus, Berlin. Paper covers. Pp. 303 with 93 illustrations. Price, RM. 15. Leipzig: Georg Thieme, 1940.

This work deals with a logical combination of therapeutic endeavors recognized and practiced abroad; namely, the employment of physical and dietetic means for alleviation of a large variety of diseased conditions. Irrespective of the merits of this contribution, many students and physicians throughout the world will read the title page with a certain amount of nostalgia and sad perplexity because of the pointed inuendo that the Rudolph-Virchow-Krankenhaus was forced by political edict to renounce the services of its once famous and now departed director of physical therapy, Lacqueur, in exchange for one now presiding in his distinguished position by virtue of political preference. Because science and medicine do not recognize geographic and national lines, the memory of Lacqueur's brilliant services in the field of physical medicine looms large and reminds one that any book written by his successor will inadvertently be judged through the tragic shadow cast by his predecessor. The circumstance recalls the several authoritative books written by Lacqueur including his most recent effort in association with his erudite Viennese colleague, Kowarschik. The advanced thoughts expressed in all of his works are as pertinent and practical today as they were but a few years ago, because they represented the collected experiences of a critical student and a lucid investigator. The only justification for a new book on a similar theme is that it represents some advanced thoughts based on new facts, or that it attempts to clarify some established but partially recognized data of value to our school of practice. The theme of physico-dietetic therapy is not new in the German literature, for the subject has been presented in book form as recently as seven years ago by Max Ostermann of Vienna. Its merits, however, lie in the direction that it lucidly reviews and presents the author's experiences in connection with the employment and procedures that have become classic in our field; namely, the diversified clinical uses of hydriatics but this includes a rather brief description of a cumbersome technic of colon irrigation. The author apparently has not had access to the newer literature on colon lavage as practiced in America and accordingly this feature of his exposition suffers the sins of omission. In defense of this thesis it is pointed out that there is much in it that is excellent, even though it is a repetition of what has already been better presented by others. Indeed, the subject of physical measures and their clinical application is presented in concise and clear style and beautifully illustrated. The chapters on employment of moist, dry, contrast and medicinal baths are well presented and should be profitable reading for any clinician. There are other discussions that are somewhat brief as compared with their therapeutic importance—heat, light and high frequency current, but these are balanced by splendid expositions on massage, exercise. Where the author falls short of convincing his readers is in the field of dietetics, in which section he is not only vague but comes close to that form of position often found enthusiastically practiced by the votaries of nature cure. The most impressive part of the book is the artistic format for which this publishing firm is noted and again complimented.

BORN THAT WAY. By *Earl R. Carlson*, M.D. Cloth. Pp. 175. Price, $1.75. New York: The John Day Company, 1941.

Dr. Earl Carlson, a spastic himself and now a distinguished authority in this field tells his life story in such an inspiring manner as to serve a definite purpose, which is to "hearten and help every person suffering from a handicap, whether physical or mental." The author is able to give much of valuable suggestion, because he has been a profound student and pioneer in this field. Discouraged by many eminent medical leaders against making medicine his profession, and further advised against making "spastics" his specialty, because the average physician "sees not more than two or three such cases a year," Carlson with support from the late Dr. Tilney and others, not only created a special "spastic" clinic at the Neurological Institute in New York City but established clinics at East Hampton in Long Island, and at Pompano in Florida. In the brief space of 175 pages and nine chapters he has reviewed the most pertinent experiences of his early childhood up through college. His studies permit him to expatiate at length on the purpose and value of "Study of the Brain" and "Mental Training" in spastic disease, all of which is summarized in a final chapter entitled, "Every Life Has Its Purpose." According to Carlson, the "spastic" should not be treated as a hopeless individual; many, indeed most, have a good brain, which too often is neglected because of physical handicap. To make the individual happy is frequently the only aim of over-anxious parents. A need for a place for the education of these handicapped persons is pointed out. Hospitals cannot educate the spastic; public and other schools do not admit these persons readily, and when admitted, they are at a very distinct disadvantage. Their best

efforts are realized not in groups of well people, because they are constantly distracted from concentrating by "fear of failure, fear of being pitied or laughed at, insecurity, and the constant hard task of mastering, training, and drilling the body, the mind and the spirit." Carlson makes a plea that while physical therapy under trained and skilled direction is one of the few hopes, there is a dread again that only physical development is advanced. Occupational therapy must play a great part. It is also emphasized that living in open air in various climates has contributed as much almost as any one other aid for the general well being of these individuals.

Few books on this subject written in recent years, have such an impelling influence on heart and mind. The narrative style is employed, and this while not as austere as that used in academic discussions, yet has that superior quality of gripping and twisting the heart. It is a work that has sincerity, honesty and sacrifice as the corner stones of a man's service to man and humanity. It embodies the profound experience of a patient who has been a doctor and as a doctor found his best métier as a teacher, and as a specialist has become recognized as an authority on this most difficult of problems. Anyone interested in this problem must first consult and then study the author and his most readable of books. It is enthusiastically endorsed to the profession.

THE 1940 YEAR BOOK OF UROLOGY. Edited by *Oswald S. Lowsley*, M.D., F.A.C.S., Director of James Buchanan Brady Foundation, New York Hospital; Visiting Urologist, St. Clare's Hospital, etc. Cloth. Pp. 488. Price, $3.00. Chicago: The Year Book Publishers, Inc., 1940.

The 1940 Year Book of Urology published under the auspices of a new editor follows the same general outline as that of previous editions and maintains the high standard of selection of material and comments as those preceding it. This year's review is in the main composed of American Urologic literature, for there has been a scarcity of foreign contributions. It is, therefore, an index of the high standard of this branch of surgery in this country. The material in general is excellent. The subject of injury of the kidney is well covered and is illuminating. The treatment of bladder tumor is given considerable attention. Many excellent articles are reviewed. The incidence of tumor of the bladder is apparently on the increase or perhaps it is the recent prominence of these discussions that brings this problem into greater light. An otherwise excellent work is marred by the review by the author of his operation for impotence, which is presented as a special article at the beginning of the book. Very few urologists are agreed that the operation has any merit. The publishers are to be congratulated on the maintenance of the high standard of their work. This volume should be accepted by all urologists as the most valuable and comprehensive review of current urologic literature.

THE 1940 YEAR BOOK OF GENERAL SURGERY. Edited by *Evarts A. Graham*, A.B., M.D., Professor of Surgery, Washington University School of Medicine; Surgeon-in-Chief of the Barnes Hospital and of the Children's Hospital, St. Louis. Cloth. Pp. 816, with 326 illustrations. Price, $3.00. Chicago: The Year Book Publishers, 1941.

The present issue of the year book differs in some respects from its predecessors. It may be regarded as a jubilee issue, since both publishers and the editor have provided especial material in honor of the fortieth anniversary of the well-known series. There is a historical review of the enterprise which recalls a bit of medical history of Chicago for the past four decades. So far as the surgical year book is concerned, it recounts the efforts of the late Drs. Murphy and Ochsner, but the present editor, too, is not only a native Chicagoan, the son of one of our most distinguished surgeons of the era just passed, but a beneficiary of the training facilities of that city. In honor of the occasion Dr. Graham prefaces the usual abstracts of the literature with an interesting review of bronchiogenic cancer. There can be no doubt that again an effort has been made to present the current surgical literature of the world in sufficient form to convey the most important essentials. That the editor is alert is evidenced by the appearance of a new group under the heading of Military Surgery (war surgery would perhaps be the preferable term), presenting some experience of the present conflict in Europe. For the rest the scope maintained in previous issues has been continued, with occasional editorial comments stressing special points. This feature becomes especially valuable when, as happens in the literature, an old method is burnished up and presented as new. The 1940 review of the surgical literature of the world in spite of the cloudy political situation, still shows life and activity of general surgery, and therefore is an invaluable reference source for surgeons and those interested in surgical problems.

INTERNATIONAL ABSTRACTS

Hyperpyrexia. J. A. Trautman.

Current Medical Literature, New Orleans M. & S. J. **92**:607 (May) 1940.

During the last ten years hyperpyrexia has been used in the treatment of about fifty diseases, but it has proved beneficial in only a few. Trautman concludes from 5,500 artificial fever sessions given 985 patients at the Marine Hospital that the air-conditioned cabinet is an effective means of inducing therapeutic hyperpyrexia at fever levels up to 107 F. Only one death occurred among the 985 patients. Hyperpyrexia appears to be a valuable therapeutic adjunct in gonorrhea, syphilis and acute exudative conditions of the eye. Sufficiently good results have been obtained in such conditions as venereal lymphogranuloma, neuritis, arthralgia, myositis, acute and chronic infectious arthritis, acute rheumatic fever, chorea, undulant fever, meningococcic septicemia and asthma to warrant its further study. The contraindications are individual. Thirty different diseases have been treated by artificial fever at the Marine Hospital. The largest group, consisting of 567 patients, was that of gonococcic infections and their complications. Of 352 patients having five hour sessions at from 106 to 107 F., with an average number of 6.5 fever sessions, 304 received adequate observation and treatment and of these 252, or 82.5 per cent recovered. Forty-two patients received sulfanilamide and, failing to respond to this, were given an average of 6.6 fever sessions at from 106 to 107 F. for five hours. Thirty-six of these were under adequate observation and treatment, and twenty-six, or 72.2 per cent, recovered. Of the 173 patients who received sulfanilamide or sulfapyridine and, failing to respond, were given an average of 2.6 ten hour sessions of fever at from 105 to 107 F. alone or with additional chemotherapy 156, or 94.5 per cent recovered. In a follow-up study of 275 of the 567 patients have been rechecked as to recurrence of gonorrhea. Of these patients 241 completed their treatment from one to five and a half years ago and thirty-four from three months to one year ago. Of the entire group, nine, or 3.2 per cent, had a recurrence. An additional eleven, or 3.9 per cent, were reinfected. Encouraging results were obtained in a group of 129 patients having gonorrheal arthritis. Of these, 102 were markedly improved or recovered. A follow-up of fifty-two for from one to five and a half years showed that all except two had maintained their degree of improvement. Of 160 epididymal gonococcic complications all but five were promptly relieved by fever therapy. Ninety-eight cases of acute gonorrheal prostatitis showed excellent results from fever therapy. Excellent results were also obtained in gonococcic urethral abscess and pelvic inflammatory disease. Since no form of therapy in syphilis can be evaluated in five and a half years, which is the longest period that any of the 187 patients with this disease was observed, it is impossible to determine what the final results of fever therapy will be. Fever therapy combined with chemotherapy appeared to be of value in the treatment of dementia paralytica, tabes dorsalis, asymptomatic neurosyphilis, acute syphilitic eye conditions, arsenical intolerance and seroresistant syphilis. — [J. A. M. A. **114**:2596 (June) 1940.]

Underwater Therapy in Chronic Arthritis. V. Eugene Frazier.

J. Missouri M. A. **37**:192 (May) 1940.

The water in the pool was maintained at a temperature of 90 to 96 F. which not only was comfortable to the patient but also helped considerably to relax the muscles associated with the involved joints, thus further facilitating motion and also reducing pain. Heat is the time-honored aid in the treatment of sore joints, and no better way can be found to supply moist heat to them than by immersion in the pool. Muscles that have been weakened and atrophied either as part of the arthritic process or from disuse are protected and also benefited by the stimulating and massaging action of the warm water. When the patient is assured that no pain will result from action of a joint (due to the effective removal of gravity) he is prompted to indulge in active motion with benefit to the attached muscle groups as well as to the joint. Perhaps of even greater benefit than that derived from the joint exercise is the benefit to the morale. The author believes the hydrotherapeutic pool is of greater benefit in the treatment of chronic arthritis than any other form of physical therapy, and that definite improvement results in a large number of cases in which it is utilized. In several hundred cases so treated not a single accident or injury has resulted.

Infection of Thoracoplasty Wounds. R. H. Overholt, and R. H. Betts.

J. Thoracic Sur. **9**:471 (June) 1940.

Overholt and Betts base their report on 701 consecutive thoracoplastics performed in the course of two and one-half years. There was a reduction in the incidence of serious wound complications to 0.49 per cent in clean cases. They attribute this to a technic of wound closure and to ultraviolet irradiation of the operating room air. They observed that when an infection did occur, it was likely to be present around a consecutive series of sutures. The use of a continuous suture in the skin was then discarded, and individual milliners' needles for separate sutures threaded with fine silk were substituted. Silver foil was used to cover the suture line.

Following the institution of this method of closure, seventeen infections occurred in 261 wounds, or in 6.53 per cent, as against approximately 15 per cent reported in the literature. Of 287 thoracoplasties performed under ultraviolet irradiation in one hospital five became infected; three were superficial and two were deep. In a second hospital similarly equipped, 124 operations were carried out and six wounds became superficially infected. The extent of the infection was limited in all cases to one or two skin sutures. Thus in a total of 411 operations there were eleven infections (2.67 per cent) but only two, or 0.49 per cent, were deep and of clinical significance. — [Abstr. J. A. M. A. **115**:489 (Aug. 10) 1940.]

Treatment of Acute and Chronic Suppurative Otitis Media. Harold I. Lillie.

J. A. M. A. **115**:506 (Aug. 17) 1940.

The author divides this class of patients into three groups. The first group includes those in whom antero-inferior perforations of the tympanic membrane overlie the orifice of the eustachian tube. Few subjective symptoms are complained of other than discharge from the ear. In the second group he includes those patients who may have had considerable central loss of the tympanic membrane and show evidence of definite pathologic change in the membrane, covering the promontory. Hyperplasia and granulation tissue are frequently encountered. It is in this group that zinc ionization is said to be useful for this particular type of condition.

In the third group no destruction in the tympanic membrane may be evident, but defects into the attic of various sizes and situation are seen.

Treatment of Acute and Chronic Sinusitis. J. Mackenzie Brown.

J. A. M. A. **115**:508 (Aug. 17) 1940.

Relief of pain in the acute stage is obtained by drugs and physical measures. Acetylsalicylic acid and codeine should be given as often as necessary. Heat or cold may be used in the form of local applications, according to individual preference. Heat may be utilized in any one of many ways. Brown is convinced that it is the heat alone that gives relief, and not the method through which it is used.

Conservative Electrosurgical Excision of Subesophageal, Chronic Penetrating or Acutely Perforated Gastric Ulcer. Reginald H. Jackson.

Ann. Surg. **112**:219 (Aug.) 1940.

Chronic, indurated, penetrating or acutely perforated gastric ulcers, situated in the subesophageal area of the stomach, present, from the standpoint of feasible surgical attack, difficult and hazardous problems. Access to the lesion may be so difficult and impractical as to preclude the possibility of a partial gastrectomy. Total or subtotal gastrectomy in comparatively young patients is repugnant except for a malignant neoplasm. Gastroenterostomy alone offers little, the beneficial reparative changes anticipated in the ulcer, through drainage and chemical change, possibly being nullified, as suggested by Deansely, by too great a distance from the lesion. Attempt at direct excision, or cautery destruction of the ulcer in addition to the performance of a gastroenterostomy may, in a subesophageal lesion, be fraught with great hazard.

The location and size of the ulcer in one case was unique, and the technical procedure employed was one which, at the time, seemed to offer little promise of being more than temporarily beneficial. The unexpectedly smooth convalescence and subsequent freedom from all previous symptoms merit a report and a description of the technical procedure followed. It offers "another way out"—a comparatively safe and easy one—for the surgeon confronted with a situation where a "gutter resection" is impracticable and a Wells partial gastrectomy, leaving the ulcer in the gastric remnant, would be a formidable and hazardous procedure.

Electrical Convulsions in Psychiatry. A. von Braunmuhl.

Münch. Med. Wchnschr. **87**:501 (May 10) 1940.

Von Braunmuhl directs attention to electrically induced convulsions, a method introduced by Cerletti and Bini and subsequently employed by Sogliani and other investigators. The correctly dosed electrical convulsion is characterized by immediate loss of consciousness and instantaneous onset of convulsions. The immediate loss of consciousness prevents unpleasant sensations. The electrically induced convulsions greatly resemble the metrazol convulsions. While chemical convulsive agents exert a gradual and indirect stimulus on the parenchyma of the brain, the electrical method has an instantaneous and direct effect. This is clearly indicated by the convulsive reactions of the muscle groups of the lower extremities (jumping-jack movements). The apneic stage of electrical convulsion is short and respiration is quickly restored. Nausea or vomiting has not been observed. Surgical complications, such as dislocations of the jaw and compression fractures of the vertebrae, have been reported. Proper placement of the patient is therefore of great significance. A distinct advantage of the electrical convulsion is that the veins do not have to be touched. This and the fact that the effects are not inferior to those of chemically produced convulsions make the electrical method the one of choice. The electrical convulsion therapy is valuable in testing responsiveness in the old cases of schizophrenia and in those with a phasic course in which relapses are likely. The author thinks that it might be possible to prevent the relapses by giving a short series of convulsions at intervals of one or two years. Such prophylactic application of electric shock is justified, since experiences heretofore have proved it harmless. — [Abst. J. A. M. A. **115**:258 (July 20) 1940.]

Physical Therapy for War Injuries. Foreign Letters, London (From Regular Correspondent).

J. A. M. A. **115**:144 (July 13) 1940.

Attention has been called in the press by surgeons and others to the need for adequate and early hospital facilities for physical therapy of war injuries. Sir George Chrystal said that the ministry of health regarded it as essential that the scheme for the management of orthopedic and war strain injuries should provide for physical therapy not only in the

early but in the recovery or convalescent stages. Patients with other types of injuries would receive any necessary further treatment of this kind, either as out-patients or from general practitioners. With regard to cases occurring in the armed forces, the ministry was planning their treatment with the War Office. At all the general hospitals in the Emergency Medical Service, massage and electrical treatment at the bedside are available. There are also nineteen special orthopedic centers at which massage, radiant heat, electrical treatment and remedial exercises would be available. At these centers there would be also departments for occupational treatment. The service provided five centers for war strain in addition to the effort syndrome center in London. Here remedial exercises and remedial occupations were being provided. These twenty-four centers are in different parts of the country. The intention was to transfer to them from the general hospitals all cases which required their special facilities. The ministry is now reviewing the hospitals with a view to ensuring that the necessary apparatus are available wherever necessary.

Temperature and Gastro-Intestinal Activity. J. D. Bisgard and D. Nye.

The Lancet **2**:399 (Sept. 28) 1940.

By recording gastro-intestinal activity under varying conditions, Bisgard and Nye have shown the possible importance of simple treatment often regarded as merely palliative. They inserted balloons into the stomach and small intestine by the oesophageal route, and into the ileum and large intestine through well-established stomata. Patients were so selected that their alimentary movements were likely to be normal. It is notorious that contraction or relaxation of smooth muscle in response to a stimulus may depend among other things on its initial tonus, and there is a possibility that the balloons might have affected this. Assuming that the recorded response coincides with what would happen in the absence of apparatus, we may accept the author's conclusion that heat and cold applied externally to the abdomen do not affect the alimentary tract in the same way as hot and cold drinks. Hot packs inhibit, while hot drinks stimulate gastro-intestinal movement. Conversely, ice packs stimulate and cold drinks have a slightly inhibitory action. Various clinical applications of these findings are discussed, most of them fairly obvious — for instance, the undesirability of applying cold externally to a person with a bleeding ulcer in the mistaken hope of inducing gastric quiescence. This consideration is heavily reinforced by the fact that such cold applications greatly increase gastric acidity, an effect which the authors think may be due to the liberation of a histamine-like substance. Animal experiments by other investigators suggest that the indirect temperature effect is reflex. The physiological aspect of the findings nevertheless needs elucidation. There is no difficulty in understanding the direct effects of heat and cold on contractile tissues, but the indirect effects are not so straightforward. One might argue that surface chilling, well-known to increase the tone of voluntary muscle, might well have the same effect on smooth muscle. On the other hand, the same stimulus is known to cause the release of adrenaline, and this has an inhibitory action on all but the sphincters of the alimentary tract. Meanwhile we look forward to the authors' promised attempt to add to the actual facts by an investigation of the possible effect of sphincter activity on the records. — [Abstr. Surg. Gynec. & Obst. 71:172 (Aug.) 1940.]

The Hot Douche. C. A. Anderson.

J. A. M. A. **114**:2449 (June 22) 1940.

Anderson found it impractical to maintain the necessary uniform high temperature of the douche for thirty to forty-five minutes until he controlled the flow with a Hoffman clamp. Now he can even use boiling water in the fountain syringe bag which is controlled by the clamp until the water cools in the tube, to escape from the vaginal tip at the desired temperature. If the douche is too hot, a slight turn of the clamp corrects it; if it is too cool, a slight release of the clamp raises the temperature. Anderson depends on the patient's sensation as to what temperature she can stand. Within a short time she begins to show a rise in temperature. My patients tell me that one bag, or half a gallon, of boiling water lasts for from forty to fifty minutes.

The author's failures have impressed on him necessity of giving fully written instructions. He reads his typewritten instructions to the patient, explains them to her and lets her take a copy similar to the ones given her. The simple little clamp solved a difficult problem.

Conservative Treatment of Pyloric Obstruction With Diathermy and Other Measures. George L. LaPorte, and George L. LaPorte, Jr.

Med. Rec. **152**:4:133 (Aug. 21) 1940.

Of nine cases of benign pyloric obstruction treated medically with diet, drugs, and diathermy, eight responded well and are considered cured. The authors are convinced that benign pyloric obstruction should be treated conservatively, and that where any doubt exists as to the nature of the lesion, a trial period of three weeks' conservative treatment should be given to differentiate a benign from a malignant lesion. Diathermy is a valuable aid in the conservative treatment of benign pyloric obstruction.

Acromio-Clavicular Dislocation. A. A. Appell.

Canad. M. A. J. **43**:23 (July) 1940.

Early cases of acromic-clavicular dislocation should be strapped with adhesive. If after two months there is no improvement it should be obvious that the coraco-clavicular ligaments are torn and that cure is impossible without surgical intervention. Appell's cadaver dissections showed that the acromio-clavicular ligament plays a minor part in the stability of the acromio-clavicular joint. This explains the failure of the older operations, such as wiring or arthrodesing of this joint. The one essential to a successful operation is the repair of the coraco-clavicular ligament, and this is best done with fascia lata.

On return to bed the patient's arm is maintained at 90 degrees abduction by means of pillows. On the third or fourth day, after he has recovered from the effects of the operation, a plaster shoulder spica is applied with the arm abducted. When the cast is dry the patient may leave the hospital. At the end of five to six weeks the cast is removed. Active and passive movements and massage will hasten the restoration of normal function.

Further Studies On the Relation of the Daily Exposure to Light to Sexual Activation of Male Starling (Sturnus Vulgaris). J. Wendell Burger.

J. Exper. Zoölogy **84**:3:351 (Aug. 5) 1940.

Sperms were formed by starlings both after a constant daily exposure to 11 hours of added "night-lighting" and after daily exposures which were initially 11 hours, but later reduced gradually by 4.5 hours. These results together with other studies indicate that spermatogenesis is not induced by an increase (or decrease) in day-lengths, but because a length of day is reached which is sufficient to be completely stimulating. In order to estimate the minimum day-length necessary for the formation of sperm, starlings were given daily either 13.5 or 12.5 hours of lighting. The "13.5 hour" birds uniformly completed spermatogenesis, while the majority of the "12.5" hour birds formed relatively few spermatozoa. A few, however, equalled the "13.5-hour" birds. Daily lighting of 12.5 hours is therefore close although slightly above the minimum day-length necessary for the production of sperm.

Convulsive Therapy — Feldman and Davis

(*Continued from page 91*)

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